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Engineering News-Record

Devoted to Civil Engineering and Contracting
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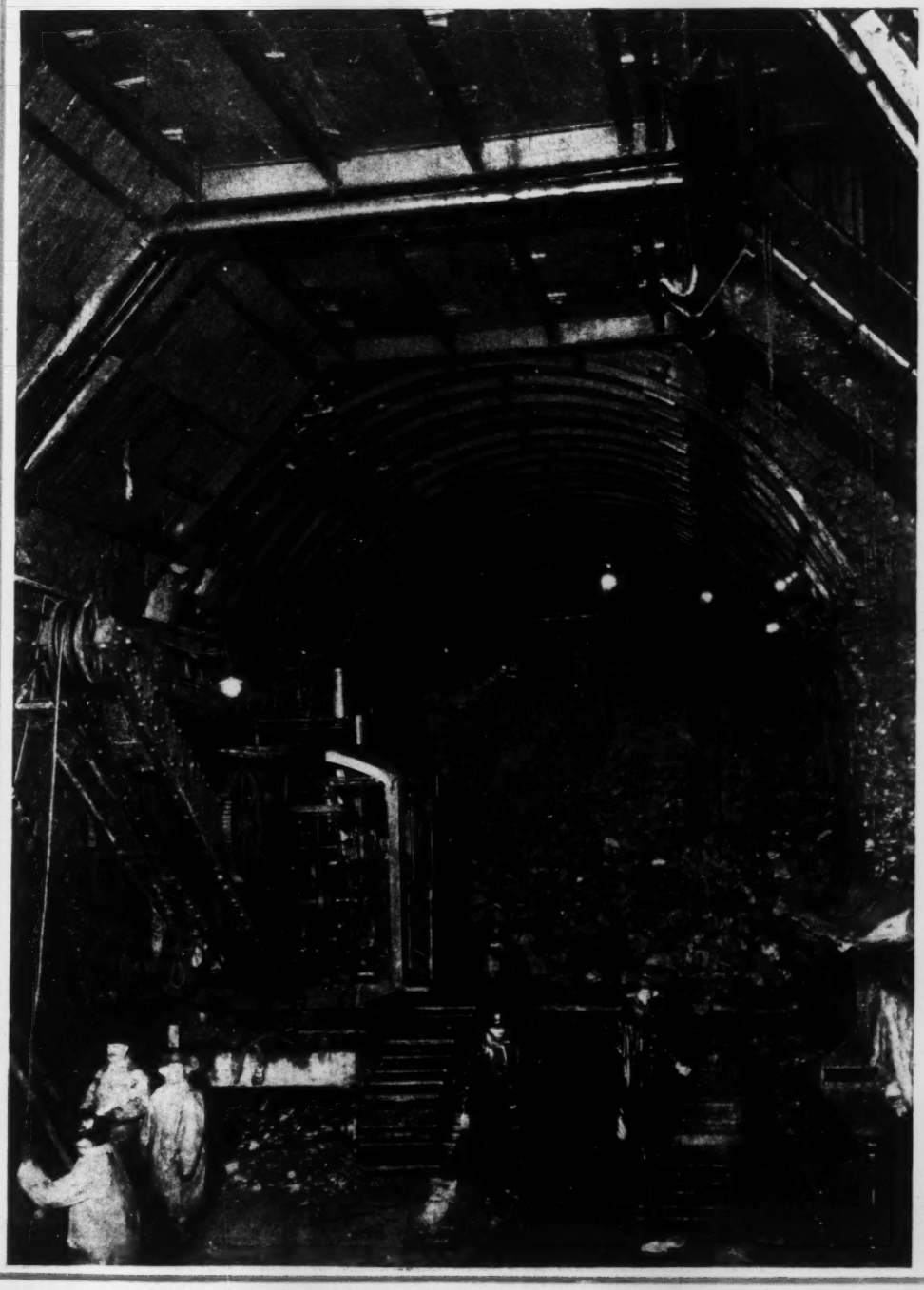
Driving 32-ft. Siphon Tunnel for the new American Niagara Power Tunnel

A Proposed Uniform Drainage Law for Land Reclamation
By Jacob Harman



At Bottom of Shaft Looking Toward the Arch Heading of the Niagara Power Tunnel

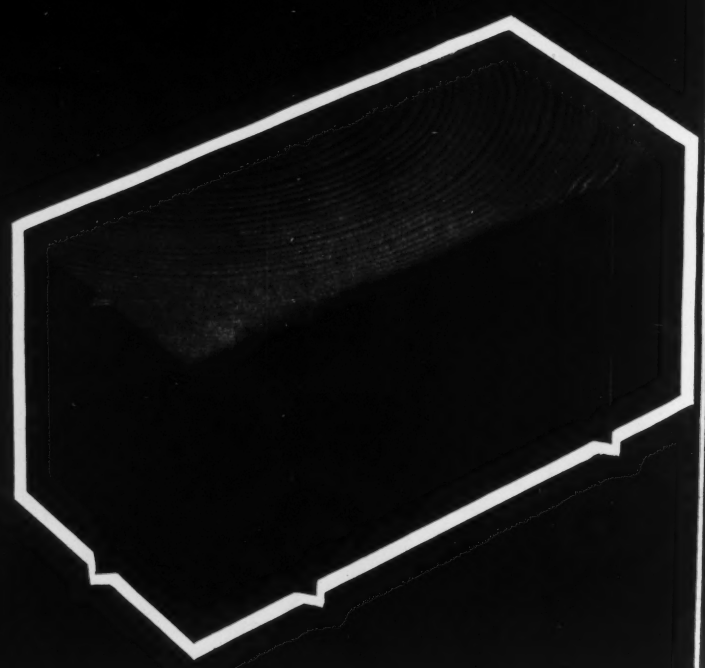
From Job and Office Section:

Hints that Cut Cost and Time for Average Engineer and Contractor

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

THE greatest contributing factor, in determining the principal business thoroughfare of a city, is the character of the pavement used. A smooth, well constructed and well selected pavement attracts business and traffic like a magnet. The magnet, which attracted the business in the case of the accompanying photograph consisted of a KREOLITE Lug Wood Block Pavement.



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 88 — NEW YORK, APRIL 27, 1922 — Number 17

Hydro-Electric Records at Niagara

NIAGARA FALLS continues to be the show place of hydro-electric development. Two years ago the record size turbines, 35,000 hp., were installed on the American side; last year, the record passed across the river and international boundary to the 55,000-hp. units of Ontario's Queenston plant, and now the Americans are about to build the largest water wheels ever attempted, the 70,000-hp. reaction turbines for an extension which not only contains these record wheels but is fed by a remarkable siphon tunnel of the largest rock section ever built, with the exception of the huge ship tunnel for the Rove Canal at Marseilles, France. The history of Niagara shows a constant increase of the unit of power from the unit of flow, and in that effort each step forward in hydro-electric knowledge and design has been utilized. So far only the Canadians have gone to the full head utilization, but that, of course, must come on both sides of the border. The next step then will be an international agreement for the use of more water which, as Col. Warren's war-time report pointed out, can be granted with no damage to scenic beauty if proper, and simple, structural precautions are taken to distribute the sheet of water over the crest of the falls. The time will come, and it is not in a hypothetical future, when Niagara, continuing to be the tourist's goal, will be turning into useful work two millions of coalless horsepower.

Municipal Bond Rate Falls

RECENT sales of municipal and state bonds promise well for an increase in construction work. Quite recently, Illinois sold $6,000,000 highway bonds, limited to a 4 per cent interest rate and running from 7 to 18 years, at a yield rate of from 4 to 3.95 + per cent. Of 20 bond sales reported in the New York *Times* for the week ending April 21, seven were offered at 4 to 4½ per cent but 12 sold to yield less than 4½ per cent. Only three of the issues were offered at as high a rate as 6 per cent. These were all county road bonds. In general, a comparison of interest and yield rates indicates that many public officials are limited by law to interest rates higher than the money market demands, or are poorly informed as to money conditions, or fearful of their selling bonds below par.

Cleaning Up the Building Situation

EVEN the man in the street who thinks but little about labor or industrial problems knows that the building industry in this country reeks with the criminality of output restrictions. Yet, even our largest cities have gone along enduring these conditions—giants bound by a system of labor pirates. Yet there is a way out. San Francisco showed it and now, as told in this issue, Chicago is freeing itself from the yoke. It is notable that in neither instance was there a war on the unions. In fact, in the Chicago case such unions as have accepted the Landis award are retained as the medium for negotiation and operation between employer and employee. Only when the unions have refused to accept the award has the trade been classed as "open shop" and the unions been eliminated. What has been done in San Francisco, what is under way in Chicago, can be done in other cities. It requires much courage and the banding together of high-minded citizens who are prepared for a fight to the finish. Such a group of citizens will be assured of public support, even as they were in San Francisco and Chicago. The conditions that obtained in those two cities are duplicated to the same or a less degree in other large cities. The San Francisco and Chicago campaigns should be clarion calls to action.

Contributions from Practice

MANIFOLD opportunities for contributing to the advance of engineering knowledge by observation and experiment occur in the daily course of construction work. There are unsettled questions at almost every stage of engineering enterprise, and the engineer is compelled to dispose of them in his particular application by approximation or compromise. Recognizing clearly that more precise knowledge would be of value, he yet overlooks the fact that he can himself help in obtaining such knowledge by a properly planned bit of incidental research. Broadly speaking every piece of engineering work brings with it opportunities for research of this kind. In our last issue (p. 638) an instance was presented of how the opportunity was utilized, and means were provided at little cost for gathering most valuable data on stress distribution in a skew arch bridge. Facts determined from measurement on actual structures, or what we may call full-size facts, are the ones that inspire the most confidence and have the most direct and lasting influence on engineering practice. If the engineer will turn from the regular course of his professional duties long enough to perceive the unsolved problems contained in his structure, and arrange the tests and observations to throw light on them, his work will develop such facts and thereby will become of lasting benefit to the profession and to the world. We have faith that in time it will become axiomatic that every large engineering work shall be made the occasion also of scientific investigation. When that time comes—we need hardly say it is not yet here—the contributions to knowledge from the field of practice will dominate the field of engineering progress.

The Promise of Genoa

IT IS true that the United States is practically self-sustaining and that it is quite possible for all of us to make a reasonably decent living by doing each other's chores. But it is equally true that we never can enjoy great prosperity unless there exists a market that can absorb the fruits of our excess productive capacity.

For the time being a combination of causes prevents this, so the eyes of American industry are turning toward Genoa as the only agency in sight that can help us. As this is written the news from Genoa is of uncertain portent. By the time this is printed the Genoa conference may have gone up in a puff of smoke. Yet there is much reason to hope that many vexing questions will be ironed out and that, at the very least, a foundation will be laid for a future conference in which the United States may play an important part. To the average American, Genoa seems a long way from home. To the American engineer the interests there represented and the problems there discussed may seem of but remote concern. But this will be changed if he will but remember that until those interests are reassured and those problems solved there can be no adequate market for our surplus products, and that until there is such a market there can be no return of the national prosperity that will stimulate production and encourage expansion. It is to these activities that the engineer and his associates of the constructive industries must look for individual prosperity.

A Distinctive College Magazine

THOSE who have watched the development of the College of Engineering and Commerce of the University of Cincinnati expect from it the unusual. There is always something fresh about Cincinnati's approach to its problems. The same characteristic of distinctiveness is found in the magazine which the students of the college started last fall. The standard form of engineering-college publication is that of a technical magazine. Effort is made, of course, to carry to the alumni and the students a story of recent happenings in the institution, but by and large the distinctive features are technical. Not so with "The Co-operative Engineer," as the Cincinnati magazine is called. It purposes to portray the activities and thinking of the student. It recognizes that they are dealing with technical studies, in training for a technical career, but it appreciates, also, that they are human beings with all of the reactions incident to the glowing period of student days. Consequently student activities come in for a heavier share of attention than would normally be expected in an engineering-college publication. That alone would mark the publication as "different." The chief distinctive feature, however, lies in the effort to have the students record the reactions upon them of this work in the industries (which takes up half of their time). This contact in the hands of men with quick perceptions furnishes much human material.

Data on Truck Loading

TRUCK overloading is the subject of outstanding interest in the analysis of Connecticut's highway traffic census which Prof. J. Gordon McKay of the University of Wisconsin is making and which will shortly appear in these pages. The count made last year on two of the state's trunk-line highways leading from Hartford respectively to New York and Boston showed that every third truck was loaded beyond rated capacity and that overloading occurred with pratcically all types of commodities, thus disproving the belief often expressed that overloading is confined largely to building materials, including sand, stone, brick, cement, and lumber.

In the second Connecticut census, covering the New York traffic, of the total number of trucks loaded in excess of 25,000 lb. gross weight, the state limit, 88 per cent were also overloaded beyond the capacity of the truck. Figures from this census showed, however, that only 51 out of 2,183 trucks, or 2.3 per cent, exceeded the maximum allowable gross weight limit of 25,000 lb. and only 4.2 per cent exceeded in capacity the 5-ton truck. On this basis the 28,000-lb. gross weight limit recommended in the proposed uniform vehicle law would have little effect on present traffic in Connecticut.

The figures go further than capacity overloading and gross weight overloading. In the second census the limit of 800 lb. per inch width of tire was exceeded in 12 per cent of the cases for front axle and 35 per cent for rear axles, the range of overloads running from 800 to 1,500 lb. per inch of width for the front axle, and from 800 to 1,925 lb. for the rear axle.

By far the great majority of body widths are 7 ft. 6 in. or less.

Local conditions must be taken into consideration in applying to other localities such results as were secured in Connecticut. That state has been active in enforcing its motor-vehicle laws, and consequently it might be expected that truck overloading as shown by the census here discussed would be less than in a state where the motor-vehicle law enforcement machinery was practically inoperative.

There have been so many traffic censuses consisting only of numerical counts of vehicles that the Connecticut results and their analysis, involving weights of trucks, sizes, tire widths, type of commodity carried, etc., go a step beyond what has been done before in this country, at least on a large scale. The present analysis does not deal with the ton-mile figures, length of haul and other features involved in a comparison of transport by motor truck and by rail. Possibly this phase of the question will be treated in a supplementary report. On the whole the analysis represents a pioneer effort to furnish specific, instead of general, data upon which to base discussion of highway transport by truck.

California Faces State Ownership

NEXT November the citizens of California have to decide whether they want to plunge headlong into the most stupendous experiment in state socialism this country has ever seen. The majority of those voting can pledge the resources of the state to the amount of $500,000,000 to be expended by five appointees of the government in any way they think "necessary or convenient for the conservation, development, storage and distribution of water, and the generation, transmission and distribution of electric energy." There would be no preliminary trial, no study by authorized experts, no legislative or gubernatorial veto. By virtue of the initiative law, the proposed constitutional amendment, if adopted, is self-executing.

There will be those who seek to prevent so extraordinary and, we think, so dangerous a step by shrieks of "socialism" and "look at Russia." That will not do much good. But the people of California, who by the curious developments of ultra-democracy must now decide this intricate economic question, may well be confronted with what the adoption of the amendment would entail.

They might be asked to look at Ontario, the only other

North American state which conducts a hydro-electric business and see there the pyramiding expenses which have just led a hitherto friendly government to appoint a Royal Commission to study into a Frankenstein power commission which threatens to absorb the province that created it. They might well study their fellow state of North Dakota, led by visions of successful state ownership into near bankruptcy to be saved only by a recall of its radical leaders and a reversion in policy. They may, indeed, be asked to remember the federal adventure in the business of running the railroads, with all the disasters of subservience to labor and overwhelming deficits. And finally they may think of the federal post-war operation of ships. These are actual experiemnts in what California would so hastily try. Do any of them warrant a great state sailing off so lightly into an uncharted political and economic sea?

Possibly the public utilities of California have not been perfect in their attitude to the people. They are very large and very powerful and power breeds overconfidence. But the people of California will not be punishing these utilities by voting to take them over. The public utility business is not so profitable but that its owners could well afford to take the full value the state is obliged to pay for their property and go into some other business with more profit. The ones who will be punished are the taxpayers who will have to pay for the property and who will have to stand by and see an ungoverned commission wield the resources of the entire state.

California has since its earliest days been the home of private initiative. It would mark a decided change in the temper of its people if it were next November to become the first of our American commonwealths to go into the business of generating and marketing water and power. Hazardous as the experiment is it may, if attempted, have one good result—to serve as a warning to the other states on what not to do. That, though, would be poor consolation to the victims—the people or the industries, or both, of California.

Special Privilege Pleads Its Case

IN HIS testimony before the Lockwood Committee in New York Samuel Gompers has voiced an astounding doctrine. The committee is now considering regulation of the building trades unions in which its recent investigation has disclosed vicious and oppressive abuses arising mainly from unscrupulous exploitation of the restrictive powers of the unions.

Mr. Gompers admits the existence of these evils. He deplores them. But he objects vigorously to any effort to correct them through the agency of the law. He believes in legal regulation for trade associations of employers, but not of employees. He believes in wage contracts that will bind employers as to minimum wages but will not bind employees as to maximum wages. Rather than tolerate an appeal to the courts, in a trades union controversy Mr. Gompers would leave its members without redress for wrongs committed against them by their associates. Even though a man should be expelled wrongfully and thereby deprived of a chance to earn a living it were better that the legislature should not "interfere."

Mr. Gompers professes to believe, in effect, that trades unions should be above the law, above the obligations of contract, above the canons of common decency.

This extraordinary position he justifies on the ground that the labor movement is "a rough struggle of the masses to find their way out," whatever that may mean. He would have us deal gently and sympathetically with breakers of wage contracts because we "are dealing with human beings who are benefiting by the competition of contractors." Employers should not be protected against wage-extortion, as this would interfere with "the development of human aspiration to get more out of life." When the community would invoke the law to protect itself against waste, oppression and blackmail, Mr. Gompers blandly admonishes us "to have patience and to bear with the ills we have rather than to fly to others we know not of." Mr. Gompers, in short, invokes the discredited philosophy of 1914. He would have organized labor "hack its way through" wholly wanting in respect for the opinions of mankind and treating its contracts as "scraps of paper."

The welfare and the progress of American labor do not lie along this road. The justification of the trades union is not be found in this doctrine. Fortunately for the American workman there is developing a type of progressive labor leader who is coming more and more to realize that in order to obtain the protection of the law the good citizen submits to its restraint. Employers generally, we believe, will be glad to deal with organized labor that seeks no special privilege but is willing to stand with them on a common platform of lawful rights and lawful obligations.

Proposed Model Drainage District Law

FORTY-EIGHT legislative assemblies constitute as many American experiment stations in legislation and there is an equal number of fields for testing the laws once enacted. The system has advantages and disadvantages. On the one hand it gives a free hand to meet the widely diverse conditions of a country so large and varied in population, geographical, climatic and other conditions as is America. It also affords chance o watch the results of many variations in law principles and methods, and in administrative practice. On the other hand it leads to confusion and conflict, especially as much of the legislation in the various states or the nation is crude, haphazard, governed by matters of temporary expediency and too often framed with ignorance or contemptuous disregard of what has been tried somewhere. Fortunately leaders arise at intervals here and there who realize the need for clear thinking and sound practice based on a careful study of the laws of the various states.

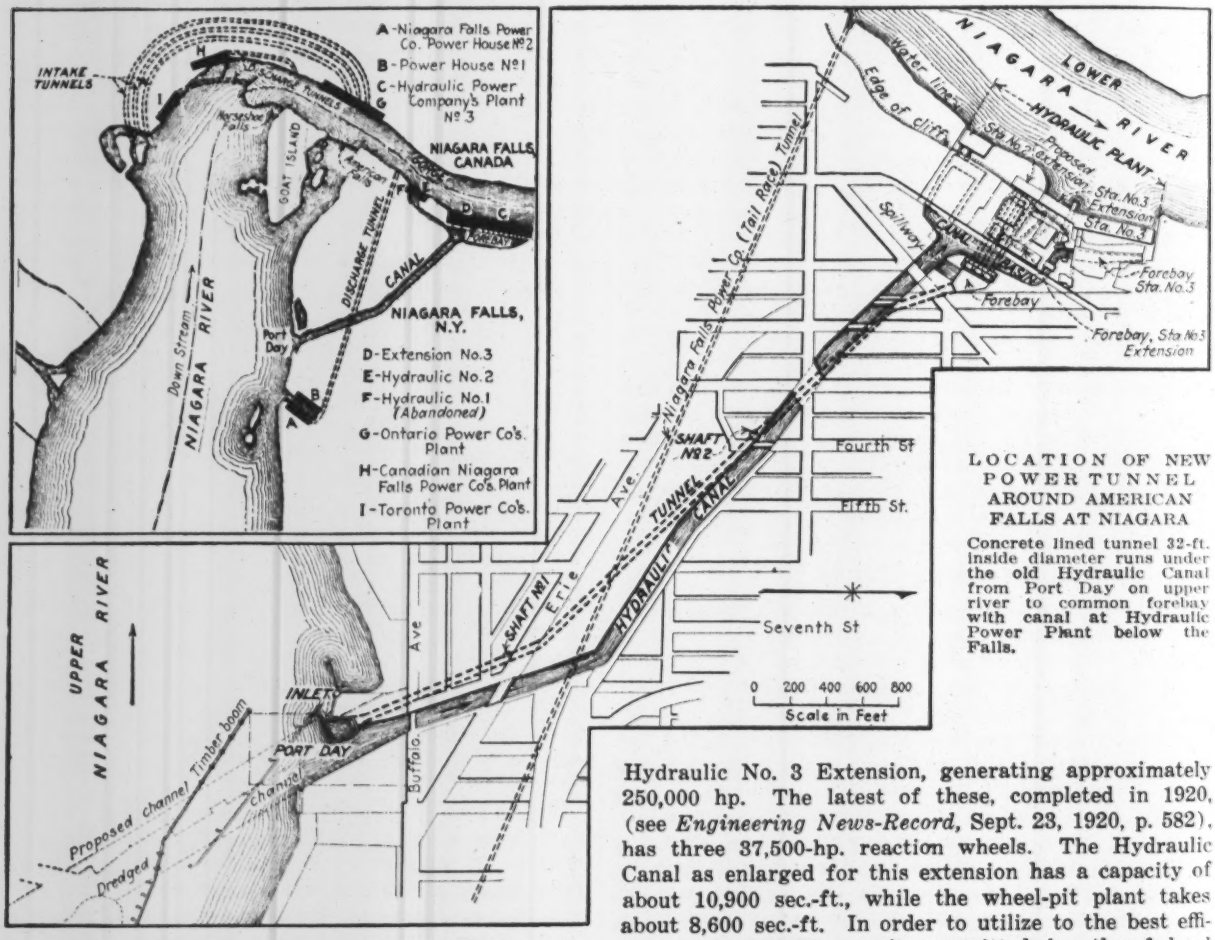
Such a man is Jacob A. Harman, of Illinois, and such a study has resulted in the proposed model state drainage law set forth by him elsewhere in this issue. The law is based on long and varied experience in connection with land drainage and drainage assessments in a number of states. It is notable for its recognition of some of the fundamental principles of representative government that have been quite overlooked in connection with drainage, flood protection, and other joint or district public improvement projects, and also for giving the engineer his logical place and influence.

Mr. Harman's article will repay study, not merely by those concerned with land drainage, but also by all who have to do with the planning and execution of large joint municipal or other district works or are concerned with sound principles of government.

Driving a 32-Ft. Hydraulic Pressure Tunnel Around the American Niagara

Additional Flow of 10,000 Sec.Ft. to Supplement Present Hydraulic Canal—210,000 Hp. in Three Reaction Turbine Units — Full 36-Ft. Width Driven in Heading 18 Ft. High

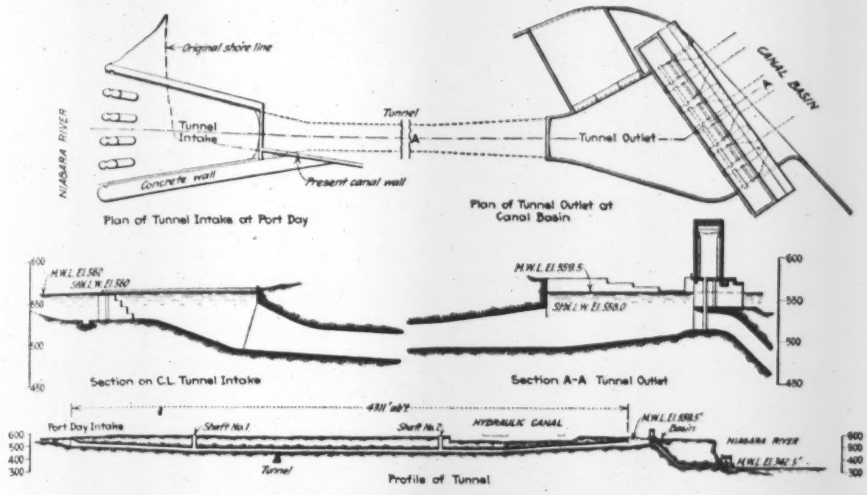
A ROCK tunnel 32 ft. in diameter inside the concrete lining, and 36 ft. inside the rock break line, is being driven for a distance of 4,300 ft. around Niagara Falls on the American side. It is in effect a siphon tunnel dipping down from the level of the upper river to a maximum depth of 130 ft. and rising to practically upper river level again at the forebay of the power plant, an extension of Hydraulic Plant No. 3 of the Niagara Falls Power Co. The flow through the tunnel, 10,000 sec.-ft. is to be utilized to supplement that of the Hydraulic Canal, which the tunnel practically parallels at a lower level, and the additional flow is to be utilized in a new power plant containing three 70,000-hp. reaction turbines, the most powerful water-power units ever built.



LOCATION OF NEW POWER TUNNEL AROUND AMERICAN FALLS AT NIAGARA

Concrete lined tunnel 32-ft. inside diameter runs under the old Hydraulic Canal from Port Day on upper river to common forebay with canal at Hydraulic Power Plant below the Falls.

This tunnel is the first step in the latest development of the power of Niagara by the Niagara Falls Power Co., which is operating under a federal water power license authorizing it to divert 19,500 sec.-ft. from the river. At present this company operates the old Niagara Falls Power Co.'s wheel-pit plant and the group of Hydraulic Power Co. plants below the Falls under a consolidation of the companies which took place during the war. The former plant has a capacity of approximately 115,500 hp. and takes water from the upper river at the power house, dropping it through penstocks to turbines in the wheel-pit from which the water runs in a tunnel to the river just below the Falls. The lower plants are served by the Hydraulic Canal which runs through the city of Niagara Falls from Port Day on the upper river to a forebay on the bluff, about ½ mile below the Falls, whence water is taken through penstocks to riverside power houses. There are here three plants, known as Hydraulic No. 2, Hydraulic No. 3, and Hydraulic No. 3 Extension, generating approximately 250,000 hp. The latest of these, completed in 1920, (see *Engineering News-Record*, Sept. 23, 1920, p. 582), has three 37,500-hp. reaction wheels. The Hydraulic Canal as enlarged for this extension has a capacity of about 10,900 sec.-ft., while the wheel-pit plant takes about 8,600 sec.-ft. In order to utilize to the best efficiency the 19,500 sec.-ft. permitted by the federal license, the company decided to relegate the wheel-pit plant, where the power production is only about 12 hp. per second foot, to a standby status and to build another lower river plant where, with modern machinery, about 22 hp. per sec. foot can be developed under the 217-ft. head available. To obtain the additional flow through the existing Hydraulic Canal would have required a substantial enlargement, which meant either additional property for lateral expansion or extensive dredging for deepening. After comparative analysis, the pressure



PROFILE OF NIAGARA POWER TUNNEL

tunnel, largely within the property already owned by the company, was selected as more economical than canal enlargement.

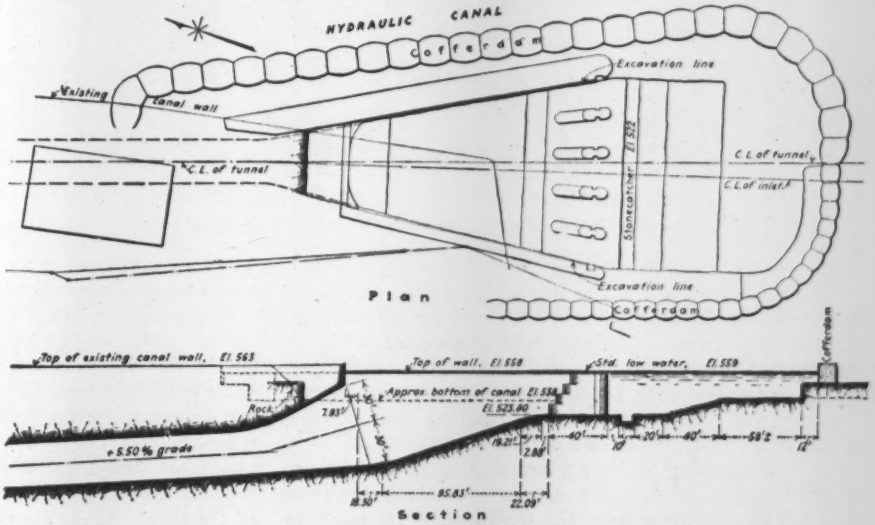
This tunnel has a capacity of at least 10,000 sec.-ft. Its inlet is alongside the inlet of the Hydraulic Canal at a mean water elevation of +562 (U. S. Lake Survey datum; adjusted levels of 1903). It descends on a 5.5 per cent grade for about 950 ft. to a level 2,300 ft. long (bottom elevation +437.0). It then rises on a 6 per cent grade to the forebay (mean water elevation +559.5). In plan the tunnel follows closely the line of the canal, the exact line being shown on the accompanying map.

In section the tunnel has a semi-circular arch and trapezoidal base with rounded corners. Inside the concrete lining (18 in. in the base and 24 in. in the arch) the maximum dimension each way is 32 ft., giving a cross-section of 875 sq.ft. The rock break is about 36 ft. in diameter, making it one of the largest rock tunnels on record. The concrete lining is not reinforced, except for the arch ribs used to hold the rock, as described hereinafter.

The intake consists of a spreading mouth cut into the rock bottom of the river and controlled by concrete side walls and gate piers in which are placed slots for future shut-off gates. The arch portal of the tunnel here is a built-up concrete structure extending a short distance beyond the rock face of the tunnel opening. The exit of the tunnel is an open forebay cut in the rock just back of the present forebay basin and opening into that basin so that the forebay of the joint power plant will be filled from both tunnel and canal. Across the forebay is the gate house controlling the entrance to three penstocks, which are 21-ft. circular concrete lined tunnels driven through the rock of the cliff on a 45-deg. downward slope to a practically level (2 per cent grade) tunnel leading to the river edge power house, where each tunnel leads water to a 70,000-hp. turbine. Tailwater elevation is +342.5 (mean). This power house will be next to and connected with the existing power-house structures of the company.

Construction is being attacked from both ends of the tunnel and from two shafts. At the upper river the intake is being built behind a coffer-dam and the tunnel carried through to just beyond the portal. From each of the shafts, located as shown on the map, at about the third points on the tunnel, the section is being carried in both directions and at the lower end the forebay is being dug, the natural rock barrier being left between the new and old forebay and the tunnel heading being carried backward from the new excavation. On the river edge the power-house foundations are being built and the headings for the penstocks are being driven along the horizontal tunnel section and upward to the forebay.

One of the views shows the work at the intake and one of the drawings the details of the protective work there. An inclosing coffer-dam of the cellular sheetpile type made familiar in the raising of the battleship "Maine" is built around the entire intake structure. This dam, of 14-in. x ⅜-in. arch web Lackawanna steel sheetpiles, is driven into the limestone rock of the Niagara district in about 10 to 26 ft. of water and filled by dumping in river sand and gravel brought down by scows from Buffalo. This filling is to be removed later by pumping. Inside the coffer-dam the area was laid dry and rock excavation to grade made in the open. Here, also, were built the guide walls and the gate piers shown in the drawing. Seamy rock was encountered at the portal of the tunnel and extensive grouting opera-



INTAKE DETAILS AT UPPER RIVER

tions through pipes entirely surrounding the intake area were required in order to keep the water down.

At the lower end the forebay excavation was made over an area about 270 ft. long and 180 ft. wide, steam shovels on crawler treads dumping into trucks which took out the spoil on an inclined roadway running out of the excavation.

The tunnel is being carried through in both directions from each of the shafts with an advance heading of the full arch and a following bench of the full trapezoidal base section. Shaft No. 2 was carried down in full section clear to the sump chamber below the tunnel bottom grade. Shaft No. 1 was carried only to arch bottom grade, and the heading started from that level. The heading is made for the full arch section, that is a semi-circle of 18-ft. radius. Jackhamer drills are mounted by twos and three on columns, of extra heavy 3-in. wrought-iron pipe, braced between roof and floor and the operators work from platforms on the columns. About ten drills are used for each heading and 80 holes averaging 10 ft. in depth are drilled to a round.

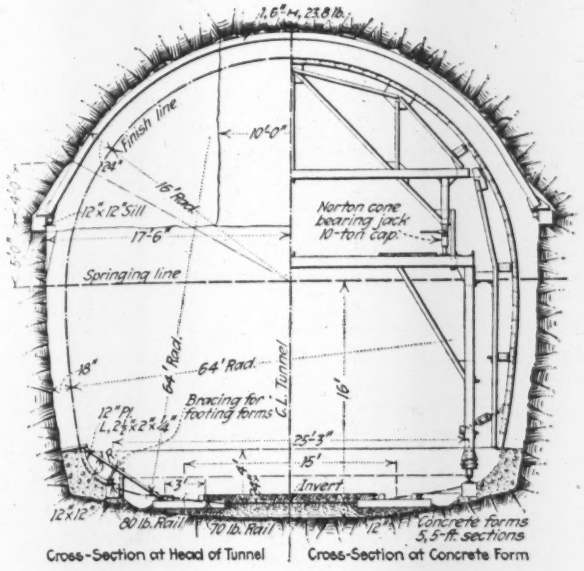
Men are working in two 9-hr. shifts, with an hour for lunch, an hour for dinner, and two hours between shifts. The day crew does the drilling, the heading is shot at 4:30 p.m., and the night crew does the mucking. Advance is being made at the rate of about 9 ft. per day, around 180 yd. in place and 350 yd. broken rock per heading.

The roof is being held with special steel arch ribs with timber lagging as shown in one of the views and in one of the drawings. As the heading is driven a bench is left along the side on which are placed longitudinal 12 x 12-in. sills as seats for the steel arch ribs. These ribs come in three sections and are made of 6-in. 23.8-lb. H-beams bent to the arch curve, and are spaced about 4 ft. on centers. These ribs are carried up close to the face and swung in place with gin poles in about ½ hr. without any other than man power. Lagging consists of 3 x 8-in. timbers extending over three ribs. At every sixth rib is an opening left to the rock face as a space for the bulkhead of the concrete forms.

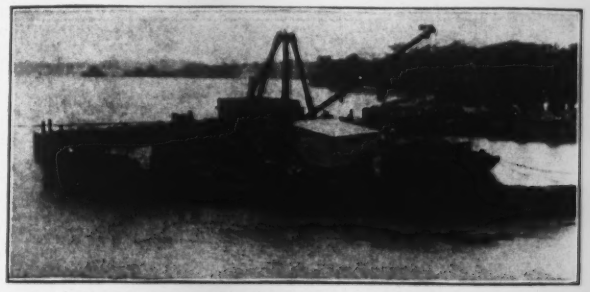
AT THE HEADING OF THE 32-FT. POWER TUNNEL AROUND NIAGARA FALLS

Jackhamer drills mounted on columns braced between top and bottom of section. Entire 18 x 32-ft. section shot at once.

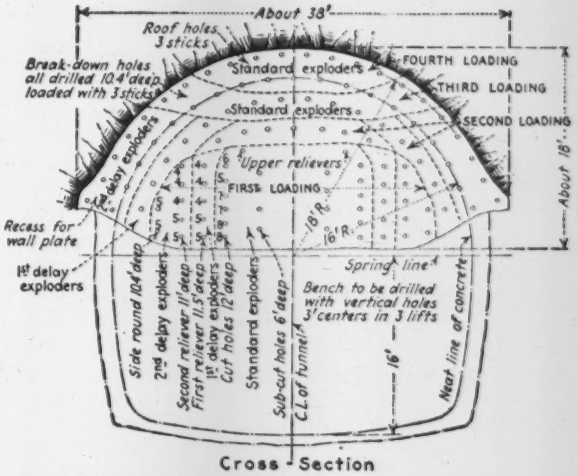
Narrow-gage track extends from the shaft up to a switch with two tracks at the heading and spoil is carried away from the heading in 4-yd. cars drawn by electric locomotives. These cars are loaded at the heading by compressed-air driven shovels with ¾-yd. buckets traveling on crawler treads. These shovels have a maximum 360-deg. swing. Their mobility, due to the crawler tread, permits them to readily reach any part of the face. After the arch is carried through the entire length the remaining bench will be carried through in one operation.

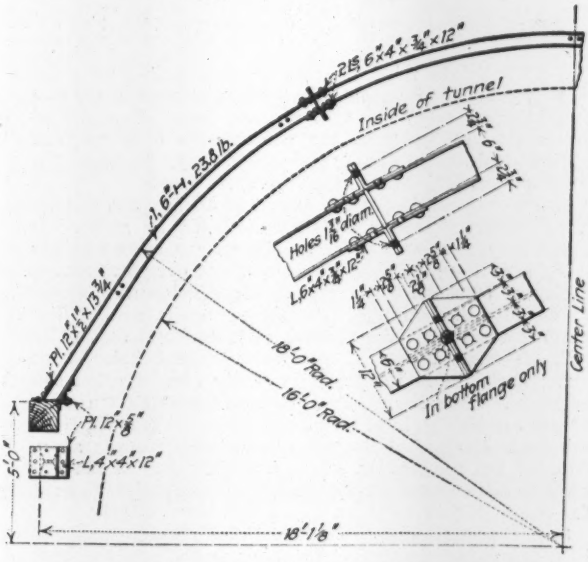


CROSS-SECTION OF TUNNEL SHOWING OUTLINE OF CONCRETE FORMS

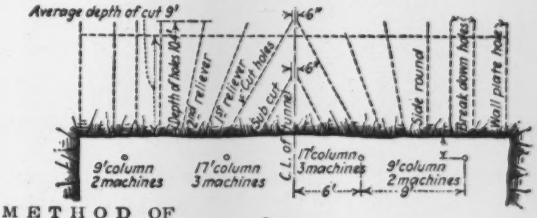


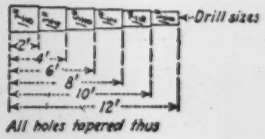
WORKING ON INTAKE OF TUNNEL, NIAGARA RIVER ABOVE FALLS





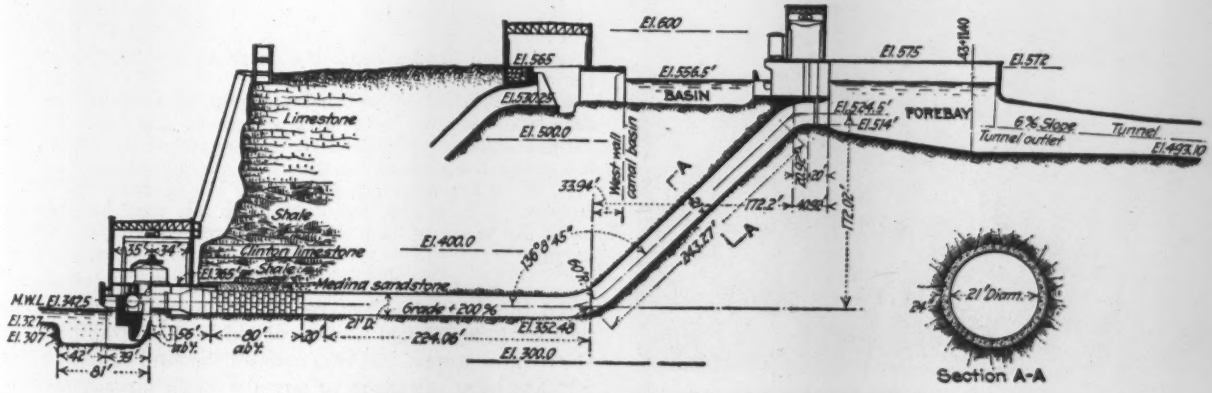
DETAIL OF RIBS FOR ROOF SUPPORTS OF TUNNEL





METHOD OF DRILLING AND SHOOTING HEADING

Total number of holes drilled in heading 110. Number of sticks of powder used 414. O indicates position of drill hole. Figures near holes indicate number of sticks of powder used. 3 sticks of powder used in holes not marked. Powder containing an exploder is counted as 1 stick. Powder data: Size 1¼ x 8 in. Strength 60%. Pounds per stick 0.54.



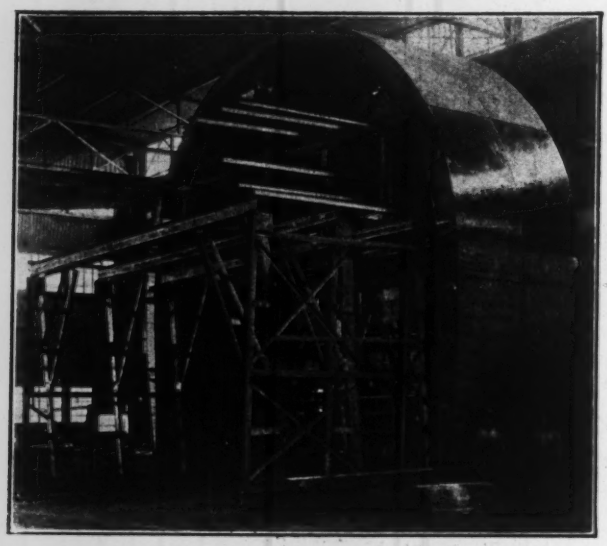
POWER-HOUSE LAYOUT OF LATEST NIAGARA DEVELOPMENT

STEAM SHOVEL CRAWLING UP SLOPE BETWEEN BENCH AND HEADING
Note arch ribs and lagging in the arch in the background.

Compressed air for operating the rock drills, drill sharpeners, hoists, shovels, pumps, etc., is furnished by three batteries of compressors, each battery consisting of two 200-hp. electrically driven units. Air aftercoolers are connected between the compressors and air receivers, and in some cases air reheaters are also used. Pump and drainage equipment is as follows: Inlet—two 12-in. pumps, two 10-in. pumps and one 6-in. pump. Shaft No. 1—One 4-in. discharge 500-gal. per min. pump. Shaft No. 2 discharges through drainage tunnel into tailrace tunnel of Niagara Plant. Outlet—one 10-in. pump working and space for one 10-in. additional. There is some water in the Niagara limestone formation here, but the conditions were not unusually severe.

The drilling diagram with data regarding blasting is shown in the right-hand column of page 681.

Concrete lining will be placed behind movable forms of the type shown in the view and one of the cross-sections of the tunnel, although this work has not yet started. These forms, made by the Blaw-Knox Co. of Pittsburgh, are 25 ft. long and travel on rails set on sills at the bottom of the tunnel. Their design and operation can be readily understood from the cross-section.



FULL SECTION OF CONCRETE LINING FORMS SET UP IN SHOP

The penstock is being driven in heading and bottom bench from the lower level. When the upslope is reached the section is carried through in a lower heading, in size 7 ft. high by 14 ft. wide, and the upper part of the arch broken down later, allowing the rock to fall down the slope into a hopper at the bottom, where it is loaded into 8-yd. cars which take it out to the river edge and where it is dumped alongside the bank.

The work was started in the spring of 1921. At present the intake work is well along toward completion, the tunnel is 40 per cent completed, and the penstocks 35 per cent completed. Work has not started on the gate-house structure.

The new work at Niagara Falls is being carried on by the Niagara Falls Power Co., of which John L. Harper is vice-president and chief engineer. Construction work is under the direction of O. D. Dales, construction engineer, and the contract for the entire construction is held by the Read-Coddington Engineering Co. of Niagara Falls.

How To Develop Water in Pre-Glacial Valleys

Abstract of paper presented to Illinois Section, American Waterworks Association, by W. D. P. Warren, Consulting Engineer, Decatur, Ill.

KEEPING in mind the fundamental principles governing the development of a shallow ground water supply (water shed area, rainfall, run-off, percolation and storage available) and realizing the relation to these factors of the deposits in the pre-glacial valley, the methods of development may be summarized as follows:

1. An examination of the extent of all possible watershed areas within reasonable distances should be made. As a rough rule, a city of 2,000 population can economically develop a well supply at a distance of not over 5 miles, while a city of 50,000 might economically develop a well supply 15 to 20 miles away, depending upon the availability of natural reservoir sites relative elevation and cost of land.

2. An examination of well records, test holes, borings and other data in the territory under consideration should be made. Such records can often be secured from coal, oil or gas companies, local well drillers and, in Illinois, through the State Geological Survey. Some such records are confidential but the portion relating to the depth of the glacial drift usually is not so held, and can generally be secured for use in the investigation of a municipal supply.

3. A thorough study of all available records with a view to determining the dip of the rock or shale at the base of glacial drifts in the location of a pre-glacial valley is essential. This study should be made before the location of any additional drill holes is considered. Often the elevation disclosed by the records of two or three old holes will indicate the direction of the pre-glacial valley. Further investigation should definitely establish the boundaries of the valley.

4. The location of test holes should be made in accordance with the foregoing data and these test holes should furnish sufficient additional data upon which to determine the possibilities of any sites under consideration.

5. When the complete data as to the fundamental principle are before one, the conclusion can then be reached as to the value of such a supply compared with a surface supply.

Status of Federal-Aid Road Funds

To the end of February, 1922, Congress has appropriated $339,875,000 as federal aid for road building in the several states. Of this amount the sum of $214,723,000 has been set aside to pay for work already undertaken.

Plain Concrete Sewer Acts as Beam After Washout

By Orrin E. Stanley
Sewer Engineer, Portland, Ore.

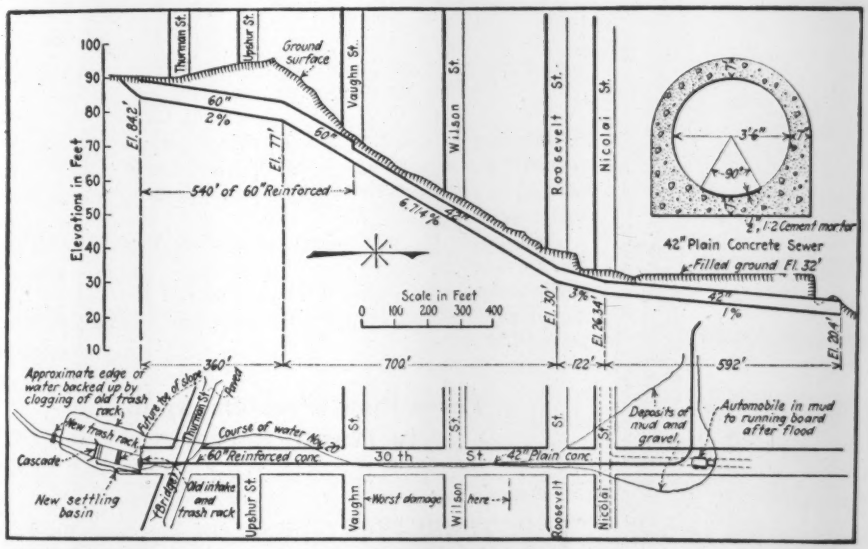
A MONOLITHIC concrete sewer in Portland 42 in. in diameter, with 7-in. walls, left unsupported for a length of 40 ft. by having the earth washed from under it by a recent freshet, remained practically true to line and grade, and stood without cracking until temporary supports could be placed under it a day or two later. A 50-ft. span of the same cross-section cracked at the middle and ends of the suspended section and leaked through the middle crack at the bottom of the sewer.

The washout which exposed the sewer and carried away the supporting material occurred Nov. 20, 1921. About 4 in. of water had fallen in the three days' storm. Throughout the forenoon and early afternoon of Nov. 20 the rain froze as it fell, coating everything heavily with ice. In the middle of the afternoon the rain increased in intensity and was accompanied by a marked rise in temperature, melting the accumulation of ice, and adding its volume to the rain which was falling. This caused a flood condition in the drainage area of 1,400 acres tributary to the sewer, so the trash rack at the inlet was completely clogged with debris brought down by the freshet. The rapidly rising water sought out the old bed of the creek and followed it around the high point of ground at the end of Upshur St. to the newly filled trench at Vaughn St., where it poured down a 7 per cent slope and rapidly cut away the comparatively soft material from around and under the sewer.

The Balch Gulch storm sewer at Portland, Ore., which withstood this severe test so successfully, is essentially a long culvert, having no manholes in its entire length of 1,774 ft. It was built in the summer of 1921 and carries the water of Balch Gulch from the toe of the slope of a future fill in Thurman St. to the west edge of filled ground west of 31st St. and north of Nicolai St. Here it empties into the old creek which meanders over the flat lands to the Willamette River approximately a mile distant. Owing to the undeveloped state of the drainage district, as well as the low value of the lands which must be traversed by this sewer when built, it was decided to construct only this short section at this time. From Vaughn St. to the outlet the sewer follows the line of an old flume which was installed to care for the water of the creek when its bed was filled several years ago. In some places the bottom of the concrete sewer rested on gravel fill above the old bed of the stream. This loose material was easily washed out, leaving the sewer resting only upon occasional points of rock and hard clay.

Early the morning following the freshet men were sent to open the intake and let the water again flow through the sewer. After this had been accomplished, the work of placing temporary cribbing under the longest spans was begun and permanent repairs were soon started. Concrete piers 1 ft. thick, extending the full width of the sewer, were built every 10 ft. for a distance of 350 ft. These varied in height from 1 to 5 ft. Their footings, which were 2 ft. wide, were carried down to hard material. The cracks in the barrel of the sewer were covered with heavy collars of concrete.

A "settling basin" protected on the sides with plank walls, was constructed above the intake. This basin is 33 ft. wide and 100 ft. long. It has a comparatively flat slope, and the water falls into it over a cascade built of planks spiked to long stakes driven in the creek bed. At the lower end of the basin, where the grade is steeper for about 20 ft., the bottom is protected by a plank floor. An additional trash rack was built across the basin 50 ft. from the old one at the end of the sewer, and a third one was placed 200 ft. farther up the creek. This upper screen has its bars spaced 8 in. apart.



PLAN, PROFILE AND SECTION OF SEWER WASHED OUT AT PORTLAND, ORE.

The 60-in. reinforced-concrete sewer and most of the 42-in. plain concrete sewer were undamaged, and but little damage was done to the latter, although two stretches of it were left without support. The only streets paved are Sherman, Wilson west of 30th, Nicolai, and (planked only) 30th Street, north of Nicolai.

More than 3,000 cu.yd. of material were required to backfill the washed-out gully. This was replaced by teams at a cost of 65c. a yard. The clearing of the pavement was done by force account teams and all other work was done by the Bureau of Maintenance of the City of Portland under the supervision of O. Laurgaard, city engineer. The total cost of labor and materials on the job exceeded $6,000.

Licensing Laws in Sixteen States

The following sixteen states have enacted engineering license laws, according to a compilation just issued by the American Association of Engineers: Arizona, Colorado, Florida, Indiana, Iowa, Louisiana, Michigan, Minnesota, New Jersey, New York, North Carolina Oregon, Pennsylvania, Tennessee, Virginia, and West Virginia. The foregoing information is correct as of Feb. 22, 1922.

FROM JOB AND OFFICE

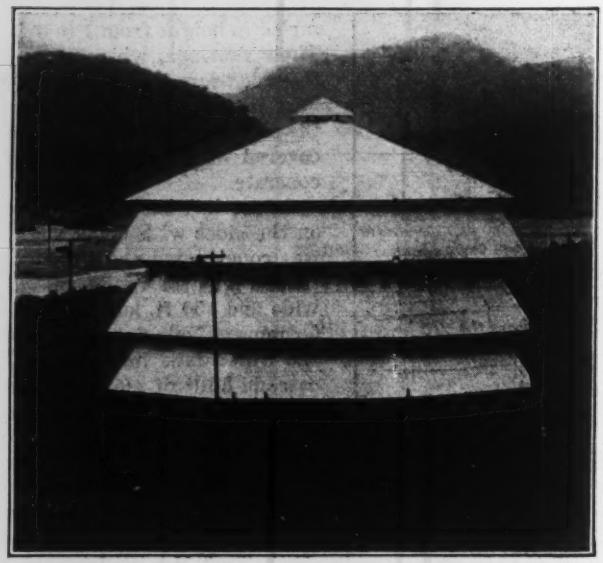
Hints That Cut Costs and Time For Contractor and Average Engineer

Protection of Tanks Saves Gasoline From Evaporation

BY R. Z. KIRKPATRICK
Chief Hydrographer, Panama Canal

LOSS FROM evaporation of gasoline in large storage tanks in the Panama Canal Zone was reduced practically two-thirds by encircling the tanks with corrugated iron and corrugated asbestos.

In the accompanying view is seen the type of protection given the new 220,000-gal. gasoline storage tanks. The tanks are 40 ft. in diameter and 24 ft. high and are connected by pipe lines to and from oil cribs for taking gasoline from tankers or delivery to ships. When the tanks were unprotected it was found by a test taken



COVERING REDUCED GASOLINE LOSS TWO-THIRDS

over an average of thirty days that there was a loss of 25 gal. per day through volatilization. The first attempt to reduce this loss led to painting the tank white and protecting it at the top by the hood shown in the view. Such protection reduced the volatilization 20 per cent.

Later the two lower petticoats were added, cutting the actual evaporation losses to 8¼ gal. per day. The upper petticoat and the hood were made of corrugated asbestos and the two lower petticoats of corrugated iron.

Multiple Steel Slabs For Large Column Bases

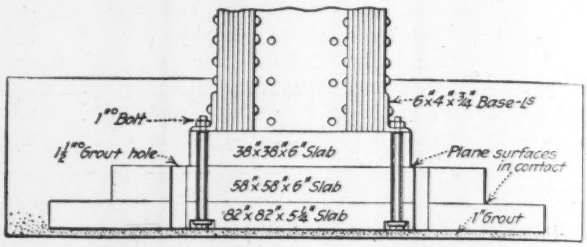
BY EUGENE W. STERN
Consulting Engineer, New York City

A COLUMN BASE which I have been using in my practice for some time past consists of layers of rolled-steel slabs, one on top of the other. All surfaces coming in contact are of course planed.

For light loads a single slab can be used, and this has been the practice among some designers, but the usual method to increase the spread of the footing under heavy loads has been to place steel grillage beams under this slab.

The reason for discarding my grillage type of column base (shown in *Engineering News*, May 23, 1912, p. 984), is that the rolled slabs are cheaper and take up much less depth. The latter is an important consideration where rock excavation is necessary for footings.

The drawing shows a base 82 in. square, as built, supporting a column having a load of 3,400 tons. The



HEAVY COLUMN BASE OF STEEL SLABS

foundation is hard rock. If this base were properly made of grillage beams, it would cost almost double. As compared with steel castings, the slabs are cheaper and more dependable.

As regards the method of calculation, I will leave this to the mathematical experts to enlighten us. I myself believe that in the case of an unyielding foundation the cantilever method is perfectly safe with 16,000 lb. per sq.in. unit stress.

Three-Point-Problem Applied to Transit Surveys

BY J. R. JAHN
Williams and Jahn, Consulting Engineers, Berkeley, Cal.

THE THREE-POINT PROBLEM has been used in the field for years by plane-table topographers as a means of locating on the map the position in the field occupied by the instrument. For them the graphical solution is satisfactory and convenient. Among surveyors who use the transit the problem has had but slight use due to the involved mathematical processes that would ordinarily be substituted for the graphical method of the plane table. The writer has been using the three-point principle in transit surveys for years and believes that others will be interested in its application.

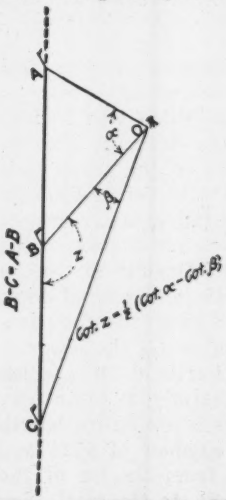


FIG. 1. CASE I, FLAGS ON STRAIGHT LINE

The advantages of the three-point problem method are: (1) The saving of time in traversing and measuring back-bearings and, (2) the greater accuracy in rough country which results from the substitution of an accurate instrument and a trained instrument man for the usual method

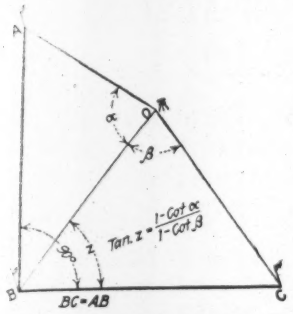


FIG. 2. CASE II, FLAGS ON RIGHT-ANGLED LINES

of measuring distance by tape. The method is not adapted to subdivisional work although it may be used there as a check by reading angles at traverse points.

The general problem.—For the general problem, three signals must be located in the field with respect to the survey. The transit, when set up at any point within range can measure the horizontal angles subtended between pairs of these signals, two pairs being sufficient. The bearing of one of the signals is then computed from the known data after which all the necessary elements are known for finding the length of the line connecting the transit point with one of the signals. This ties the transit point into the survey. The problem may be so modified that it can be used to determine the bearing of the line between signal and transit before the topographical field work commences, i.e., there are special cases of the general problem that simplify the process of orienting the instrument.

Modification of general problem.—Two such methods of arranging the signals are shown in Figs. 1 and 2. In Fig. 1 (case I) the flags are set equidistant on a straight line of known bearing and in Fig. 2 (case II) at the corners of a right triangle having equal legs also of known bearing. The transit is set up at any other convenient point and the two inner angles are read. The surveyor then calculates the angle z by the use of one of the following formulas:

$$\text{Case I} \quad \cot z = \frac{1}{2}(\cot \alpha - \cot \beta)$$

$$\text{Case II} \quad \tan z = \frac{1 - \cot \alpha}{1 - \cot \beta}$$

in which α and β are the two observed angles and z, the angle OBC. The bearing of OB is found by applying the angle z to the bearing of BC. The transit may then be oriented and the bearings of field points read on the horizontal circle at once. If the line BC be set on the meridian, the angle z will be the bearing of OB or its supplement.

Rules of sign.—Certain rules of signs must be followed. If an observed angle lies between 90 deg. and 180 deg., its cotangent is negative and equal to cot (180° — the angle). In case I if the expression $\frac{1}{2}(\cot \alpha - \cot \beta)$ is negative then z is greater than 90 deg. In case II the quadrant between courses AB and BC is positive in sign and if the fraction is positive, the line OB or its extension lies within it. If either α or β is read on the backs of the angle, their signs are opposite the normal value. The needle bearings of OA, OB, and OC should be read to give a natural check on the calculated results. The solution will be impossible if the point O lies (case I) on the line ABC or (case II) on the circumference of the circumscribing circle.

To locate the transit position for mapping, the length of OB must be calculated. If the length of the line BC is known, the length of OB can be calculated from the sine formula

$$OB = \frac{BC \sin (z + \beta)}{\sin \beta}$$

For consistent work the datum for elevations should be carried up to the transit by leveling methods and the HI of the instrument read from a turning point or bench mark. However, where the accuracy of the survey allows vertical angles may be read on a fixed target of known or assumed elevation on one of the signals and the HI calculated, using the formula: Difference of elevation = calculated distance × tangent of vertical angle. This error will be 0.3 ft. per 1,000 ft. for each minute of error in reading the vertical angle.

Explanation of general case.—The general case (Fig. 3) in which the signals do not have the relation of length and bearing as in Figs. 1 and 2 can be solved by determining the bearing of the closing line of a five-sided traverse consisting of the two known courses AB and BC, the two courses AB cot α and BC cot β, and the unknown side. The latter is a line whose longitude and latitude differences equal the algebraic sum of the longitude and latitude differences of the four known courses. The bearing of the line OB is at right angles to this closing line.

The explanation and proof of this general case is apparent from a study of Fig. 3.

The circumferences of the two circles are the loci of all points at which the courses AB and BC subtend the angles α and β, respectively; and the intersection at O of the two circles is the only point which can satisfy the given conditions.

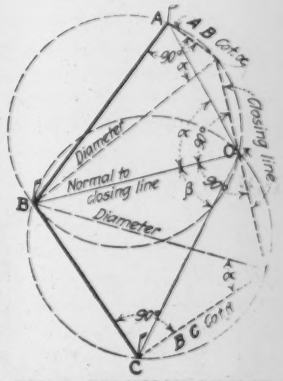


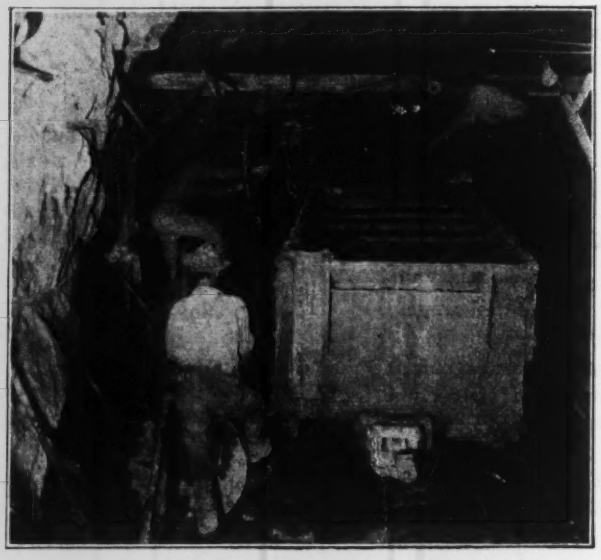
FIG. 3. SOLUTION OF THE GENERAL PROBLEM

Ingenuity is a big asset

in engineering-construction work. The office engineer or construction foreman who possesses it and capitalizes it is a valued employee. A man may have an ingenious idea as to the performance of a certain piece of work, but unless the idea is expressed concretely, put to work as it were, it is valueless. The setting forth of new ways of doing work both in the office and on the job is the function of these pages. If the unique method you have devised is worthy of your employer's consideration, it will be worthy of ours. We will be glad to receive manuscripts specially designated as "Job and Office" possibilities.——*Editor.*

Movable Hopper Saves Time in Loading Concrete Cars

IN DELIVERING CONCRETE to the pneumatic gun used for placing lining in the Kern Canyon tunnel, engineers of the San Joaquin Light & Power Corp., designed a movable hopper which materially speeded up the work by making it unnecessary for the electric locomotive to spot cars accurately at the point where they were loaded. The hopper and the cars were very similar in size and arrangement, both having six 11-cu.ft. compartments. The hopper, however, had only

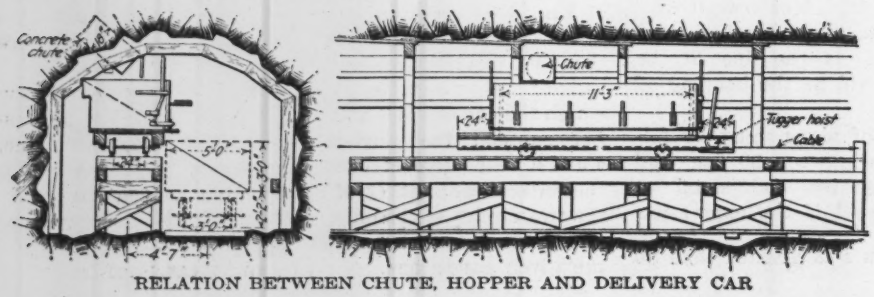


CONCRETE BEING DELIVERED FROM CAR TO GUN
Rear end of gun is seen in lower left foreground

one gate; when this was tripped all compartments discharged simultaneously. The cars were provided with a separate gate on each compartment.

The motive power for the hopper was a small Tugger air hoist mounted on the hopper body and operating a cable wound several times around the drum of the hoist and deadened at both ends of the elevated track on which the hopper moved. A single Tugger served for operation in both directions.

The advantage of this arrangement was that the movable hopper could move along beneath the discharge end of the chute and thus get a uniform loading of all compartments. When the delivery car arrived on the track below, the hopper could be spotted quickly and accurately by an operator who tripped the single door, filling all compartments of the car. The car could then be taken into the tunnel and the 11-cu.ft. batches delivered, one at a time, to the gun.



RELATION BETWEEN CHUTE, HOPPER AND DELIVERY CAR

FROM JOB AND OFFICE

Hints That Cut Costs and Time

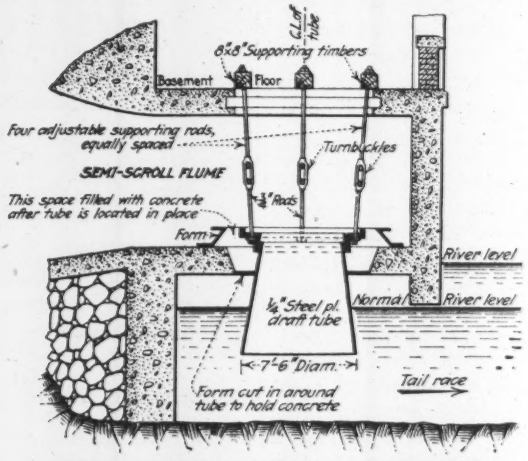
Draft Tubes Hung by Turnbuckle Rods While Concreted in Place

BY HARLAN M. BRYANT
Milton, New Hampshire

DURING the construction of a reinforced-concrete hydro-electric plant, one of the problems that had to be solved was the setting of the draft tubes. Instead of the curved concrete draft tubes used of late, the owners decided to use the older type of plain steel-plate tube riveted to the cast-iron curb ring under the wheel case. It was first planned to cast this piece into the flume bottom when that was poured.

It happened, however, that the manufacturer could not ship the draft tubes until long after the flumes were to be cast. The plans of the flumes were then altered to leave a beveled hole through which the draft tubes could be lowered and concreted in whenever convenient.

The erection men were confronted with an awkward situation in supporting the draft tube while it was being concreted in place; a situation complicated by the fact that the work had to be done when the river was in



METHOD USED FOR SETTING DRAFT TUBES

flood. The water filled the tailrace and even partly entered the flumes, making work from below the flume impossible.

The scheme occurred to the writer of hanging the draft tubes from the floor above. The arrangement shown in the sketch indicates the conditions met, and the solution. After the tube was hung as shown it could be leveled as a transit is leveled, by using the turnbuckles as one would use leveling screws on a transit.

Eight ¾-in. iron rods were cut to suitable lengths and threaded to take the turnbuckles and nuts on the ends. These four adjustable supports were hung from 8-in. x 8-in. timbers laid across the hole so as to come over the quarter points of the draft tube. It was evident that, if instead of

FROM JOB AND OFFICE

For Contractor and Average Engineer

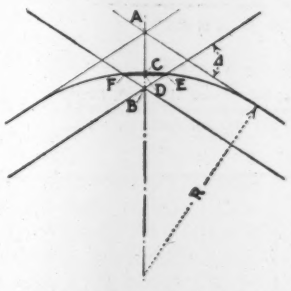
being vertical the rods sloped outward, the tube remained immobile the better. Before the rods were placed the draft tube was lowered into the pit by a crane. The weight was taken off the crane by putting in the rods and taking up the turnbuckles until they carried the load. The chain falls of the crane was then unhooked and moved out of the way. With the turnbuckles the draft tube could be placed to exact grade. It was centered in the pit by shifting the supporting timbers on the floor above.

We had center lines scribed on the concrete floor over the flumes and plumbed down from a straight edge laid out over the hole. When the tube was hanging about in the correct position the forms were dropped in around it and wedged tight. These forms held the tube from swaying with the waves in the tailrace so that it was set quite closely. The hole was then filled with concrete, care being taken to disturb the tube as little as possible. After the concrete was poured but before it set the tube was trued up.

Extreme care was necessary in this last operation as the cast-iron top of the draft tube must be level in order to make the waterwheel and generator shafting line up properly. It was done by laying a straight-edge across the machined part of the curb ring. A machinist's level then showed when the tube was properly trued up.

Solving a Slip-Switch Track Problem

HOW TO DETERMINE the proper curve for a slip-switch connection between two railway tracks intersecting at a flat angle was a problem recently presented by a correspondent. This problem was submitted to W. C. Armstrong, chief engineer of the St. Paul Union Depot Co., St. Paul, Minn., who sent in three solutions, the first of which was worked out by him and the others by G. H. Wilsey, structural engineer for the company. Lack of space permits only the printing of Mr. Armstrong's solution, as follows:



In the diagram let:

R = radius of curve required

g = gage of track

Δ = angle of crossing

D = short diagonal of diamond $A\,B = \dfrac{g}{\cos \frac{1}{2}\Delta}$

E = external secant $A\,C$,
$= \sqrt{R^2 \tan^2 \frac{1}{2}\Delta + R^2} - R$

C = chord joining intersection points E and F
$= \dfrac{g \cos \frac{1}{2}\Delta}{\sin \Delta}$

M = middle ordinate to the chord $E\,F$
$= R - \sqrt{R^2 - \frac{1}{4}C^2} = R - \sqrt{R^2 - \dfrac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}}$

Then $E + M = \frac{1}{2}D$

$$\text{Or } \sqrt{R^2 \tan^2 \tfrac{1}{2}\Delta + R^2} - R + R - \sqrt{R^2 - \frac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}} = \frac{3g}{4 \cos \frac{1}{2}\Delta}$$

Which is reduced as follows:

$$R\sqrt{\tan^2 \tfrac{1}{2}\Delta + 1} - \sqrt{R^2 - \frac{g^2 \cos^2 \frac{1}{2}\Delta}{4 \sin^2 \Delta}} = \frac{3g}{4 \cos \frac{1}{2}\Delta}$$

$$\frac{R}{\cos \frac{1}{2}\Delta} - \sqrt{R^2 - \frac{g^2}{8(1 - \cos \Delta)}} = \frac{3g}{4 \cos \frac{1}{2}\Delta}$$

and

$$- \sqrt{R^2 - \frac{g^2}{8(1 - \cos \Delta)}} = \frac{3g - 4R}{4 \cos \frac{1}{2}\Delta}$$

$$R^2 - \frac{g^2}{8(1 - \cos \Delta)} = \frac{9g^2 - 24gR + 16R^2}{16 \cos^2 \frac{1}{2}\Delta}$$

$$\frac{8R^2(1 - \cos \Delta) - g^2}{8(1 - \cos \Delta)} = \frac{9g^2 - 24gR + 16R^2}{8(1 + \cos \Delta)}$$

$$8R^2(1 - \cos^2 \Delta) - g^2(1 + \cos \Delta) = 9g^2(1 - \cos \Delta) - 24gR(1 - \cos \Delta) + 16R^2(1 - \cos \Delta)$$

$$R^2(-8 + 16 \cos \Delta - 8 \cos^2 \Delta) + 24gR(1 - \cos \Delta) - 10g^2 + 8g^2 \cos \Delta = 0$$

$$R^2(4 - 8 \cos \Delta + 4 \cos^2 \Delta) - 12gR(1 - \cos \Delta) + 5g^2 - 4g^2 \cos \Delta = 0$$

$$4R^2(1 - \cos \Delta)^2 - 12gR(1 - \cos \Delta) + g^2(5 - 4 \cos \Delta) = 0$$

$$R^2 - \frac{3gR(1 - \cos \Delta)}{(1 - \cos \Delta)^2} = -\frac{g^2(5 - 4 \cos \Delta)}{4(1 - \cos \Delta)^2}$$

$$R^2 - \frac{3gR}{1 - \cos \Delta} = -\frac{g^2(5 - 4 \cos \Delta)}{4(1 - \cos \Delta)^2}$$

$$R^2 - \frac{3gR}{1 - \cos \Delta} + \frac{9g^2}{4(1 - \cos \Delta)^2} = g^2 \frac{1 + \cos \Delta}{(1 - \cos \Delta)^2}$$

$$R - \frac{3g}{2(1 - \cos \Delta)} = g \frac{\sqrt{1 + \cos \Delta}}{1 - \cos \Delta}$$

$$R = \frac{3g}{2(1 - \cos \Delta)} + g \frac{\sqrt{1 + \cos \Delta}}{(1 - \cos \Delta)}$$

$$R = g \frac{3 + 2\sqrt{1 + \cos \Delta}}{1 - \cos \Delta}$$

For $\Delta = 15$ deg. on standard gage, $R = 802$ ft. $= 7$ deg. 9 min. curve.

Nomographic Chart for Cross-Sectioning

BY C. P. MOWRY

Morford and Mowry Engineering Co., Seattle, Wash.

THE accompanying monographic chart, designed by the writer, gives the volumes of earthwork for varying lengths of stations and sums of end areas, with an accuracy sufficient for most purposes and with a minimum of eye-strain on the part of the user.

The method of use is given below the chart. Results are more easily read from this or any other chart of this type, when employing a transparent strip of celluloid with a hair line scratched upon its lower surface. This method permits of more readily reading results as no part of the scale is hidden and interpolations are more accurately estimated.

The chart may be quickly constructed in the following manner: Draw three parallel lines spaced equidistant and intersected near the left ends by a fourth line, which may be conveniently drawn at right angles to the other three, although this is not essential. Commencing at the intersecting line at the left, lay off the logarithms of the sum of the end areas on the upper line, and upon the lower line the logarithms of length

of station. These are both to be plotted to the same scale, that is, the length of the logarithmic unit must be the same for both. On the original of the accompanying chart, this unit was made 5 in. long, using the scale of 20 ft. to an inch.

A chart properly constructed will give correct solutions of the formula,

$$V = SL/54 = 0.0185\ SL$$

Where,

S = sum of end areas in square feet;

L = length of station or distance between sections in feet;

V = volume in cubic yards.

Upon the middle line lay out the scale of volumes in cubic yards, using a logarithmic unit of half the length of the other two scales. On the original of the chart this unit was made 2½ in. long, using the scale of 40 ft. to an inch. In laying out this scale the position must be so adjusted that log 0.0185, which is the reciprocal of 54, will fall upon the intersecting line passing through the indices of the other two scales.

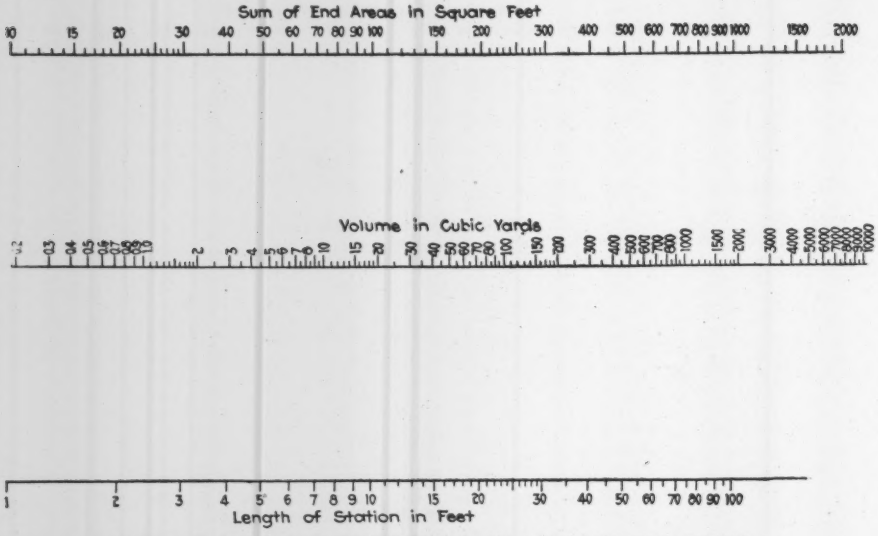


CHART FOR VOLUMES BY METHOD OF AVERAGE END AREAS

Method—Using straight-edge, or transparent celluloid having line scratched thereon, place so that edge or line coincides with "sum of end areas" on upper scale and also with "length of station" on lower scale. Read "Volume" on center scale at intersection with edge or line.

Gravel Trucks Dump From Traveling Turntable

ON GRAVEL-ROAD construction in Iowa in 1921 the speed in unloading trucks was increased by a job-devised turntable mounted on a carriage. Coming from the pit Ford trucks ran up the inclined track (Fig. 1) onto a turntable mounted as shown by Fig. 2, where they were turned through an angle of 180 deg. and then dumped through the platform. When dumped, the trucks already headed in the proper direction shot down the incline on their way back to the pit. The turntable was rotated by power. It took only a few seconds to turn the truck.

Besides acting as a turntable the device directed the spacing of the loads and, by dragging the rear cross-beam of the frame over the dumped piles, cut down their peaks and, in a measure, spread the gravel. All truck-loads were of equal volume. When a load had been dumped the operator of the table stuck the looped rod shown in Fig. 2, into the ground, making a mark. The machine was then run ahead until the pointer, shown under the operator's seat, was directly over the mark. The table was then in position to receive another truck-load.

The machine was made on the job, using two wheels from a Fordson tractor, two Ford truck wheels, a Ford engine and radiator, some I-beams for a frame, and transmission mechanism fashioned of parts readily picked up about a garage and a second-hand dealer's warehouse.

The builder was William Roorda, of Roorda Bros., Cherokee County, Iowa, highway contractors.

FROM JOB AND OFFICE

Hints That Cut Costs and Time

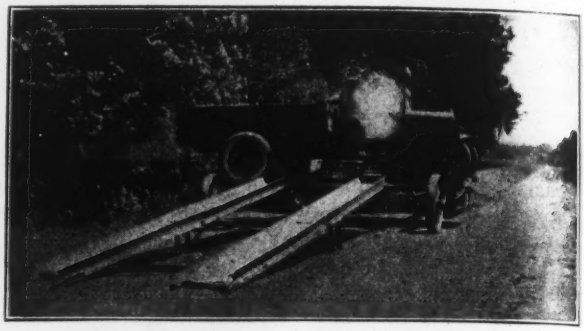


FIG. 1. TRUCK RUNS UP INCLINE TO TURNTABLE

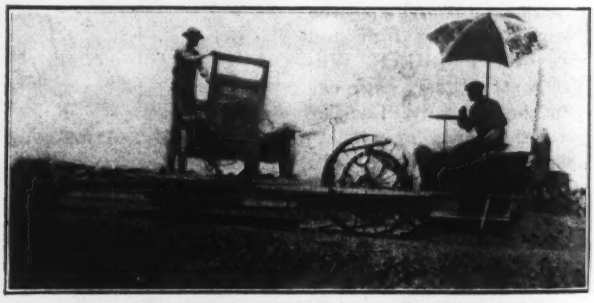


FIG. 2. TRACTION TURNTABLE SPACES LOADS

British Construction Costs Decline

(*London Correspondence*)

The latest average tenders for the construction of dwellings under the British government scheme show that a house costs £496 as against £888 in October, 1920.

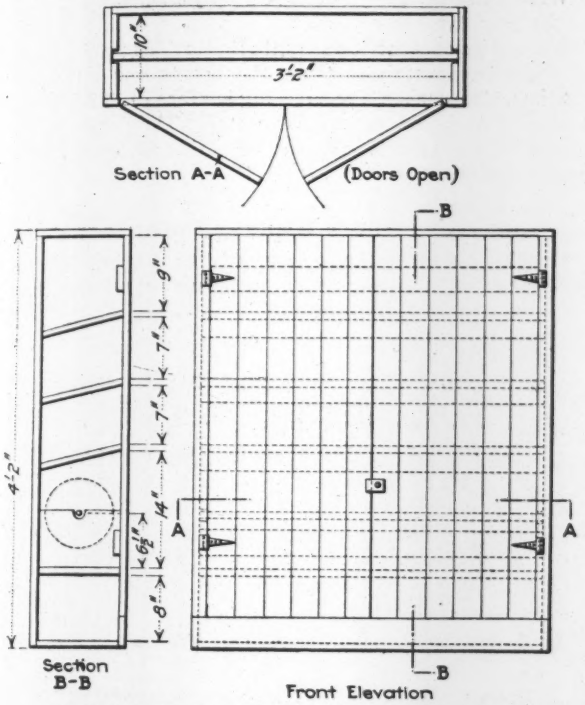
FROM JOB AND OFFICE

For Contractor and Average Engineer

Wood Cabinet for Drafting Supplies

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

IN THE accompanying sketch is shown a case which I have found convenient for use on construction jobs where it is frequently difficult to obtain a suitable container for drafting supplies such as detail paper,



DETAILS OF DRAFTING SUPPLIES CABINET

tracing cloth, etc. It can be made in a few hours by a carpenter and ordinary dressed lumber can be used. It should be made wide enough for the largest-size sheets of paper employed.

It is not necessary to remove any of the rolls in order to take off the required amount. The loose end is pulled out the required length and the finger is run over the paper on the square edge of the shelf, leaving a mark for cutting. A ten-cent paring knife is suspended by a string on the inside of one of the doors and is used for cutting the paper.

The 50-yd. roll of detail paper is mounted on a roller.

Measuring Tape Marked in the Field

By Kenneth S. Dodd
Liverpool, England

IT WAS recently found necessary to drop anchors in the River Mersey, in England, at certain points which had to be located accurately with reference to the end of a pier. A length of steel wire was used to give the distance from the pier to the position of the anchor. At the shore end, where the wire ran over a pulley, a weight was attached to give a constant tension and dip. The length of wire necessary was measured on shore by hanging the wire between two points the required distance apart, one end being fixed.

The problem was to mark the wire in such a way that it would stand rough usage.

Strips of thin tin-plate were cut out and bent around the wire. They were coated on their inner surfaces with a layer of "Tinol" (a paste which appears to consist of ground-up solder and a flux). The flame of a match supplied sufficient heat to melt the Tinol, and it was found that the strips of tin showed no tendency to loosen even though the wire received rough handling.

Heavy Penstock Part Lowered Down Incline on Cradle

AS described in *Engineering News-Record*, March 23, p. 472, the penstock for the recently-completed Caribou hydro-electric plant in California is for a part of its length a steel pipe on an incline and in a shaft. All material was brought to the site on the upper level approximately 1,500 ft. above the power house, and lowered down the 68 deg. narrow-gage incline built between the upper and lower levels. The accompanying view shows how a 17-ton piece of the penstock was handled. A feature of this lateral pipe is the cast-steel elbow on the top side of the 60-in. pipe, to which is riveted a 42-in. section. The entire piece thus reduces a 60-in. penstock to two 42-in. penstocks.

The piece is shown just entering a 500-ft. shaft into which all penstock lines are built. The piece here shown was lowered in place on a small rigid truck consisting of four 12-in. wheels connected by a frame made of extra heavy wrought-iron pipe. A double set of shackles—one fastened to the truck and one fastened to the penstock—was used to lower the piece into position. A plow-steel cable, 1½ in. diam. connected to a powerful slow-speed hoist was used for the work of lowering.

LOWERING A 17-TON PENSTOCK PART ON A CRADLE.

Bascule Door for Airship Hangars Built in France

SINCE the World War commercial aviation has gained considerable impetus among the countries of Europe. The construction of airdromes, therefore, has become somewhat of a problem in its technical details and not the least of these is the provision of doors which will allow maximum utilization of entrance and exit space. There has recently been constructed at the airdrome of Villacoublay near Paris, says a recent issue of *Le Génie Civil*, four hangars measuring 35 m. in length and 30 m. in depth (inside measurement). The height of these hangars is 8½ m. from floor level to the bottom of roof trusses. The conditions, therefore, which confronted the designers of the hangars were:

1. The openings for which doors were to be provided were 35 m. x 8.5 m.; 2. the door frame was not to be placed further than 3 m. from the front of the hangar nor more than 9 m. from the end of the structure; and 3. the mechanism supplied was to permit of the opening and closing of the door within 5 min. with a minimum of personnel.

The door finally constructed and which is illustrated in the accompanying sketch is a circular segmental frame made of sheet iron, 1 mm. in thickness, which incloses completely the hangar front. This segmental frame is stiffened by T-irons following the circular form of the door shell, and by five horizontal girders placed as shown in the figure. They are spaced on 2-m. centers and are slightly longer than the door itself. They are designed to withstand the wind pressure. A system of cross-bracing with small T-beams assures to the segmental frame great rigidity.

At the ends of the building beyond the door and the column supports of the roof girders are set two frames made of lattice steel girders. The segmental areas forming the door itself are riveted to this frame which is rigidly braced. The ends of these frames are extended beyond the axis of rotation and attached thereto are counterweights which put in equilibrium the entire structure. The counterweight of each frame is inclosed in a metallic box which has a certain amount of lateral and longitudinal motion, and is made slightly larger than need be to hold the counterweight metal. Into this small space are wedged wooden pieces and by their mixture with the cast-iron molds of a very different weight allow the easy displacement of the center of gravity of the door system.

This entire frame is set upon an axis supported by well-braced latticed steel column supports at either end of the hangar. The column supports are strongly buttressed by inclined beams and both beams and columns encased solidly in masonry footings.

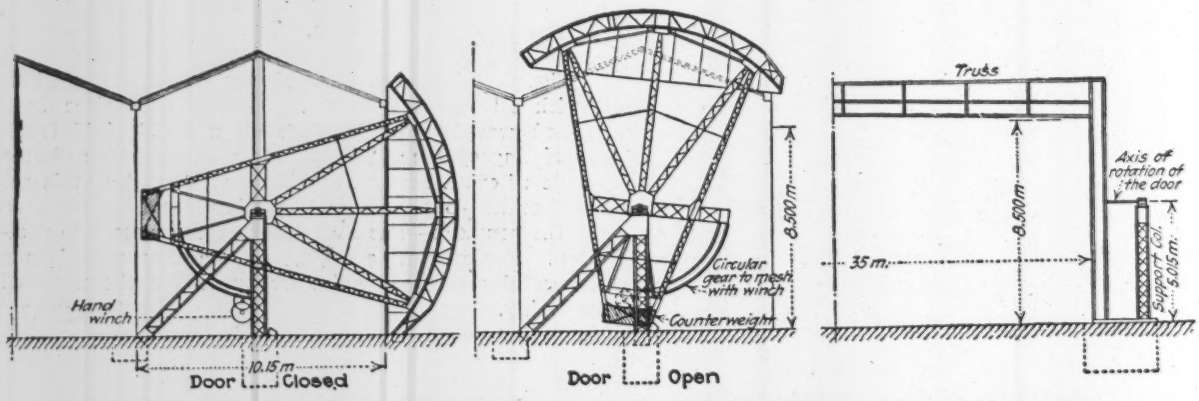
The doors are operated by hand winches attached to the column supports, and each is operated in a circular geared frame bolted to the girders. The doors can be operated at either end from within by signals to the operators of the hand winches.

When raised the segmental section just clears the ends of the roof trusses.

The entire contruction is quite light: The roof frames of sheet iron weigh 4½ tons; the beams and stiffeners 7.3 tons. This makes, for a closing surface of 297.5 sq.m., a loading of 40 kg. per square meter. The door and its frame girders weigh 40 tons, of which 22 tons is the counterweight.

Minnesota's Highway Dollar

Graphs showing the source of the average dollar expended for highway work in Minnesota have been included in the 1921 report of the state highway department. One graph shows that the average roads dollar is made up of 63 cents of road- and bridge-tax funds, used on local roads, and 17 cents of motor vehicle taxes, 8 cents of federal-aid and 12 cents of county-reimbursement-bond money—the three trunk-fund sources of revenue. Another pictures how 53 cents of the average trunk dollar went for new construction, 39 cents for maintenance, about 6¾ cents for equipment and less than 1¼ cents for general administration expense. Of the average dollar used for new construction on trunk routes, 40 cents went into permanent grades to make lasting foundations for highway surfacing that future traffic may demand, 17 cents into gravel surfacing, 26½ cents into paving, and the remaining 16½ cents for miscellaneous items. Eighty-two cents of each maintenance dollar was paid for labor. Men and teams got 43 cents of the dollar, against 28 cents paid men and trucks. In addition, laborers took 6 cents of each average dollar. Other items making up the dollar were about 7 cents for gravel, culverts and other materials, about 10 cents for equipment operation and less than 1 cent for unclassified items.



END ELEVATIONS AND HALF FRONT ELEVATION OF HANGAR EQUIPPED WITH BASCULE DOOR

State of Maine To Build Modern Pier in Portland Harbor

CONTRACTS have been awarded for supplying piles, for dredging, for constructing a sea-wall at the shore end and for building the substructure of a new public pier at Portland, Maine. The pier will be located on Commercial St. adjacent to Atlantic Wharf of the Grand Trunk Ry. Terminal and will front directly on the 35-ft. main ship channel. It will be served by the Grand Trunk Ry., and by the belt line of the Portland Terminal Co., which connects all the railroads entering the city.

Present plans contemplate a length of 1,000 ft. and a width of 144 ft. at the outer end, increasing to 236 ft. just beyond the present end of Franklin Wharf, and increasing still further toward the inner end. Eventually the pier will be 320 ft. wide throughout its length. The berth adjoining the pier will be 35 ft. deep at mean low water for a width of 125 ft. and the berth adjoining Atlantic Wharf on the opposite side of the slip will be 125 ft. wide and 30 ft. deep, increasing gradually to 35 ft. at the property line. Berths on the easterly side will accommodate two transatlantic ships and those on the westerly side at the outer end will care for coastwise craft.

As far as the outer end of Franklin Wharf the new pier will consist of a concrete deck on 80 to 90 ft. creosoted piles. Over this portion of the deck will be a steel-frame shed, 90 ft. wide and two stories high at the inner end and one story at the outer. Between the shed and the edge of the pier will be a standard-gage track and a single rail for future installation of a gantry crane. Provision will be made also for cargo hoists of the New York type. On the westerly side of the shed will be several standard-gage tracks, depressed so that car floors will be lever with the shed floor. The tracks and adjoining roadway will be planked or paved to permit trucks to back up over the track to the platform.

At the outer end the easterly side of the pier will have a timber deck with a steel and wood pier shed 60 ft. wide extending from the end of the steel shed to the end of the pier. The standard-gage track will be continued over this section of the pier. The steel columns of the shed are designed for the later installation of gantry cranes.

West of the railroad tracks and outside the limits of the present Franklin Wharf will be built a wharf with a timber deck having a shed similar to that on the easterly side at the outer end. This, being for coastwise liners, will have drop gangways with inclined dock elevators for handling freight to and from coastwise vessels having side-ports.

The pier, as planned, will provide: (1) A berth and pier shed for the largest transatlantic ships that will come to Portland, with grain-handling facilities, freight-handling equipment, and passenger accommodations. (2) Berth and pier shed with freight-handling equipment for smaller transatlantic ships and those plying to Pacific ports. (3) Berth and pier shed for New York and Philadelphia coastwise vessels. (4) Berth for intra-harbor vessels. (5) Existing berth and pier shed on westerly side of Franklin Wharf to be kept for coastwise service.

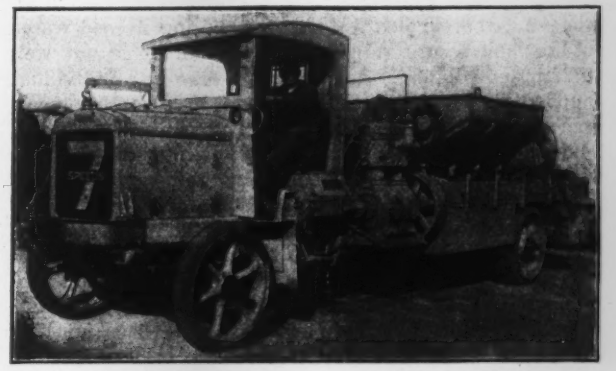
The state legislature has approved a bond issue of $1,150,000 for the construction of the pier. Plans and specifications for the pier sheds, grading, tracks and other facilities are now being prepared, and it is expected that the new pier will be in operation early in 1923.

Henry F. Merrill is chairman of the Directors of the Port, and Fay, Spofford and Thorndike of Boston are consulting engineers.

Many Features Contained in Highway Maintenance Truck

MEANS for carrying through practically every operation required in the repair of any sort of highway are combined in a new highway maintenance motor truck which is being given a trial by the Board of Supervisors of Kern County, Cal.

The truck carries the following main equipment: (1) An air compressor; (2) an air receiver fitted with a safety-valve, gage, 200 ft. of 1-in. hose, and connections; (3) combination material bins with space for 1,000 lb. of cement, 1 cu.yd. sand, and 2 cu.yd. of gravel or rock; (4) a 150-gal. water tank; (5) a concrete mixer; (6) a centrifugal pump; (7) a power-driven



NOVEL HIGHWAY MAINTENANCE TRUCK

nigger-head winch; (8) 50-gal. tank fitted with gas burners for heating road oil; (9) a pressure oil distributor with nozzle and hose; (10) a paint-spray outfit with hose and connections; (11) a pneumatic jack-hammer with a set of chisels, tampers, etc.; (12) a pneumatic post-hole digger and connecting hose; (13) a grading plough and road drag; (14) a wheelbarrow; (15) a 10-ton jack and bracket; (17) 200 ft. of 1-in. manila rope; (17) 25 ft. of tow chain; (18) stencils for miscellaneous lettering; and (19) the following miscellaneous tools and equipment—three shovels, two picks, one large sledge, two crowbars, ten red lanterns, ten "At Work" signs, and ten red flags.

The air compressor is driven by a belt from the forward drive shaft and the concrete mixer by an auxiliary shaft from the transmission. The concrete materials are fed by gravity from all the bins to the mixing apron through hand-operated gates. Water from the tank can be withdrawn either by gravity or pressure. The road plough and drag when in use are attached to an extensible steel boom fitted to the front end of the truck. The truck also contains a draw-bar attachment for hauling trailers.

The multiplicity of uses to which this truck may be put is obvious. It was designed by the Fageol Motors Co., Oakland, Cal.

A Proposed Uniform Law for Land Reclamation by Drainage

An Explanation and Complete Digest of a Suggested General Drainage Law For State Enactment Together With an Abstract of Existing Laws

By Jacob A. Harman
Consulting Engineer, Peoria, Ill.

Land drainage is one of the most important engineering and economic necessities of the future but its necessary development is being retarded by cumbersome laws or by absence of any law which permits co-operative action of those benefited. Mr. Harman, in his extended drainage engineering practice in the Mississippi valley, has devoted many years to the study of drainage laws and has prepared the text of a state law which is intended to promote drainage development and to make it more attractive. This article outlines the current situation as regards drainage laws, states the requirements of an ideal law and gives in extended digest the clause by clause contents of the law. For those who are interested further, "Engineering News-Record" has printed the full text of the proposed law, copies of which may be obtained by addressing this office.—Editor.

A LARGE part of the most fertile agricultural lands in the United States have been brought to their present high state of productivity through the construction of works for protecting the land from overflow, removing the surplus waters, or bringing needed water to the land where rainfall is too small or is not well distributed during the growing season. Individual landowners working independently or in co-operation can operate in a limited manner, but it early became necessary to provide laws for the organization of districts, representing groups of landowners and having taxing powers and the right of eminent domain.

Private corporations organized for the purpose of reclaiming swamp and overflowed lands in the humid regions, and particularly for irrigation in the semi-arid regions of the United States, have operated to a considerable extent, but their experience has been unsatisfactory in so many instances that the organization of drainage districts and of irrigation districts as political subdivisions of the state, with taxing powers, is now generally recognized as the sound and practical method of procedure. The demand for agricultural land in the United States during the past three decades has brought about the development of new systems of laws for reclaiming swamp lands and for irrigation in many states, these laws having procedures fundamentally the same but varying greatly in detail.

I. Development of Drainage and Irrigation Laws

Laws of the Central States—Ohio, Indiana and Illinois were among the first states to enact workable drainage laws for the reclamation of wet land. Other central, western and southern states have followed the principles of local self-government and special taxation. Many of these states have two or more distinct and independent drainage laws, differing in details of procedure and management. In some states, especially Arkansas and Florida, it is not uncommon to establish drainage districts by direct legislation, but most states have general laws under which the owners of land may procure the organization of a drainage district and thereafter control its management by the selection of the administrative officers.

In many states the drainage laws have been enacted within the past ten years. The Missouri law has been used to a greater extent as a model than the older laws of Illinois and Iowa. The Missouri form of law provides for an independent municipal corporation, with officers elected by the land owners. These officials adopt plans, manage the business of the district, and levy and collect taxes, subject to a review by the court of the amount of damages and the equitable distribution of the cost based on benefits to be derived by reason of the improvements.

The drainage laws of Illinois became effective about 35 years ago, following generally the older laws of Ohio and Indiana. The Iowa laws were given their present form about 15 years ago, following the Illinois "Farm Drainage Act" method of taxation, but placing the management in the county administrative officers, instead of creating a local political subdivision under the control of landowners. The Missouri drainage laws were put into present workable form about ten years ago, although under the drainage laws previously in force in that state many drainage districts were organized beginning 20 years ago. The conservancy law of Ohio follows in the main the principles and practices of the Missouri law, but it gives broader power and defines in greater detail the methods of procedure.

A Department of Conservation was authorized by the Indiana legislature in 1919. In February, 1921, the Division of Engineering was added, with a state engineer who is directed to collect data and make computations relative to drainage works, define the natural watershed boundaries and advise courts and other officers relative to the organization plans and methods of construction of drainage districts. In its present form the law requires that the advice be given by the state engineer upon request of a court, or of commissioners or a landowner. The clerk of the court or commission organizing a district must notify the Conservation Department of all the proceedings for the organization of the district.

This law, through the advice and co-operation provided for, probably will have the practical effect of giving the state engineer direct control of drainage plans but apparently fails to give the authority to approve or disapprove plans and to provide for the administrative control over land reclamation works vested in the state engineer of Minnesota and of many far western states. The advisory functions are more fully provided for in the new Indiana laws than in any other that have come to the writer's attention.

Irrigation and Drainage—In the dry or semi-arid

regions, where land reclamation involves irrigation and drainage, a system of laws has been developed to meet the peculiar situation growing out of the necessity of fixing water rights for irrigation purposes and administering the distribution of water. Most areas of land that were accessible to readily available supplies of water were developed by private enterprise. Irrigation became a national question many years ago when the Federal Government established the U. S. Reclamation Service under the Department of the Interior. Public funds are appropriated for the construction of irrigation works and the federal government is to be reimbursed by the sale of public land put under irrigation, and by the collection of water rentals. Drainage of irrigated lands is frequently necessary as a supplement to irrigation.

Ad Valorem and Benefit Taxes—Under laws providing for the organization of districts in Texas and Louisiana, taxes may be levied for flood protection and drainage of land on an ad valorem basis, or on the benefit basis, as the petitioners may desire. Opinion has favored mainly the benefit tax, but a careful study of the working of the ad valorem tax reveals features of merit.

When a tax is levied on a benefit basis in a drainage or levee district the lowest lands, probably remote from highways and so located as to be the last land which can be developed and put into cultivation, will frequently receive the highest tax and may be called upon to pay the interest and annual installment of taxes for from two to five years before the land can be put into cultivation. Furthermore, this land being the lowest, carries the greatest hazard in case of partial failure of the levees to protect from overflow or the ditches to give effective drainage. Under such partial failure, this low land may become the temporary storage reservoir for draining adjacent lands of more favorable elevation.

If a portion of this burden of taxation is placed upon the district on an ad valorem tax basis the lands of greater value and utility will have the greater part of this portion of the tax. Then, when the lands less favorably situated are made available for cultivation, the annual assessment for general, state and county taxes, and consequently for annual drainage taxes, will increase with the value and availability of the land. In that manner such land will pay its due proportion of the "Cost of Reclamation."

II. Basic Provisions of Ideal Drainage Law

Districts as Political Subdivisions—A land reclamation district should be organized and recognized under the law as a political subdivision of the state, and as such should be given the greatest practicable degree of self-government. The state legislature should enact the laws governing the organization of the district and the general conduct of the business. The state judiciary should interpret the laws. The district commissioners, with their appointed officers, should have full control of the administration of the affairs of the district, being authorized to adopt ordinances, rules and regulations and given police powers to enforce their orders by their appointed officers.

The most effective and economical management of land reclamation districts cannot be obtained by placing the management under the officers of the state, or some other political subdivision of the state, because such officers will necessarily consider the interests of the district as subordinate to the state or the other political subdivision for which they are primarily chosen, so that political considerations entirely foreign to the interests of the land reclamation district may frequently influence or control the conduct of such officers in the administration of the district's affairs.

Government May Act in Advisory Capacity—It may be well for the federal or state governments or both, to maintain engineering organizations with advisory powers. The desirable activities may be expressed as follows:

The government should collect and compile engineering, scientific and other useful data and information, and promptly upon verification of accuracy, make them available to the public without waiting for a critical analysis or the promulgation of official conclusions or the local application. By this course much original data of inestimable value now buried in federal and state government files would be accessible to those interested, and would be of much greater use in the advancement of individual and public enterprises.

No Federal Funds for Private Works—Federal or state aid, control and management and even initiative in the construction of works for the drainage of wet lands has been advocated in recent years by many writers and speakers. But it would seem that the experiments in government control of business, industrial and agricultural enterprises which succeeding generations repeat have about reached a stage that should make us see the necessity of decentralizing power and authority and of giving greater latitude for individual and community incentive and support. The reclamation or improvement of privately owned lands by protection from overflow, by drainage, by irrigation or a combination of these functions cannot be a proper enterprise for the expenditure of public funds, and centralized management of local enterprises is contrary to the American principle of local self-government.

Reclamation of government-owned arid lands by the Reclamation Service under federal officers with public funds presents an altogether different question. The general public represented by the government owns the lands which are developed with public funds and the treasury is to be reimbursed by the sale of lands and collection of water rents. The companion proposal that either the federal or state government should loan or guarantee the funds for the improvement of privately owned wet or arid lands is unsound and would lead to abuses on the one hand and to stagnation on the other.

Federal Land Reclamation Districts—On the other hand, there are many cases where the land that should be included in one project or where works for effective and economical reclamation include or involve territory in two or more adjoining states. Federal laws providing for the organization of land reclamation districts by the owners of the lands affected under the jurisdiction of federal courts would provide for such cases.

A federal law for the organization of land reclamation districts embracing land in adjoining states should contain the same provisions as a state reclamation law, except that the petition should be filed in the federal district court and all court proceedings usually incident to the organization and perpetuation of the district should be had in that court. An exception would be the proceedings for condemnation of property, which should

be under the laws of eminent domain in the state where the property is located.

Such a federal land reclamation district law should become effective in any state upon the approval by the state legislature and enactment of the necessary state laws to authorize the officers of the federal district to exercise the necessary powers of eminent domain, taxation and police.

Local Initiative—In drainage developments the economic law of supply and demand is the only safe guide, and the useful interpretation of the need of reclamation of more lands for agricultural purposes may safely be left to the enterprise of citizens working individually and in voluntary co-operation controlled by the majority in interest in each enterprise. It is essential, however, to provide adequate but easily interpreted laws under which such initiative and co-operation may be made effective and at the same time may protect the property and interest of the minority and of the investor in reclamation securities. The federal and state governments should make scientific studies of the principles necessary for the successful design and maintenance of such projects and should disseminate all the useful information thus gathered.

Reclamation Bonds as Investments—The market for land reclamation bonds could be extended very greatly if the state laws would make such bonds a proper investment for trust funds when approved by a designated state officer, but submission for such approval should be voluntary on the part of the officers of any district issuing bonds.

Right of Taxation—The control of the flow of water in order to prevent floods or to drain or irrigate lands is contrary to the common law principles of riparian rights and of dominant and servient estates. The courts, therefore, are jealous of encroachment on these principles and it has usually been necessary to have a specific constitutional provision for the establishment of land reclamation districts in any state. The rights are statutory and the procedure must be well defined and followed with painstaking care.

With few exceptions, taxation by special assessment proportional to the benefits received has been the basis of raising revenues, and this method of taxation has been a constant cause for controversy regarding the constitutional right and the equity in the application of the tax.

Basis of Management of Districts—Two schools of thought regarding the basis of management and control of land reclamation districts have developed: (1) The reclamation district, whether for drainage, irrigation or flood control, is an independent political subdivision of the state, entirely within the control of the owners of land or of the legal voters within the district, subject only to statutory rights and limitations. (2) The establishment of the district and its management and control are subject to the approval, or under the direct supervision, of a designated state or county official appointed for that purpose, or an ex-officio officer having other duties. Such districts may be organized upon the initiative of the land owners, but often upon the initiative of the state or county officers having control of such work. Some of the states having these features of state control are California, Louisiana, Nebraska, Massachusetts, Minnesota, Montana, Oregon, Utah and Wisconsin.

The tendency in recent years toward centralized government control of public and semi-public functions and regulation of various forms of enterprises, is in opposition to local self-government, which has always been a fundamental feature of the American system. Without undertaking to review the many arguments, it is a fair and safe position to assume that in all governmental functions the central government should be limited in its authority and activity to the safeguarding of persons and property, and that the greatest amount of local self-government compatible therewith shall be sustained. By observing the foregoing principles, the freedom of individual and community will be encouraged.

III. Elements of Uniform Reclamation Law

Progress in drainage and irrigation would be facilitated by adequate laws providing more nearly uniform and more readily followable methods of procedure than now exist. The accompanying summary of a proposed Uniform Law is based upon the initiative of the landowners and provides for local self-government. Provision for approval of plans or the administration of the works by state officers may be made by slight alterations in the text. The phraseology found in irrigation and darinage laws has been liberally used and this will simplify interpretation in the light of the decisions of the courts on present laws.

Outline of Legal Procedure—The proposed uniform law is so arranged as to present the course of proceedings in an orderly and chronological manner, which may be followed easily. A brief outline of the procedure for the organization and management of a land reclamation district, as given below, follows in general the best practice in many states, but includes some features which are new and others which are found in very few state laws. These features are noted more fully later on.

1. Preparation and filing of a petition signed by owners of land requesting organization of a reclamation district.
2. Appointment by the court of a competent engineer to make an investigation and to report in a general way on the feasibility of the project.
3. Notice by publication to all property owners that the petition and engineer's report are on file and setting a day for the hearing.
4. Hearing by the court of landowners petitioning for or against the organization of the district.
5. Finding by the court whether the district should be organized or the petition dismissed.
6. Upon the organization of the district, appointment by the court of commissioners who may be recommended by the landowners.
7. Appointment by the commissioners of an engineer, secretary, treasurer, attorney and other officers.
8. Preparation of a "plan of reclamation" by the engineer for the approval of the commissioners.
9. Preparation of an assessment of benefits and damages by the commissioners.
10. Filing of the "plan of reclamation" and the commissioners' assessment with the court.
11. Notice by publication to all landowners that the "plan of reclamation" and assessment of benefits and damages are on file, and that on a day set the court will consider and determine the amount of damages and ratio of benefits that will result to each tract of land. If "cost of reclamation," including damages, will exceed benefits, plans will be referred back to the commissioners and unless plans are offered which will cost less than benefits, the district will be dissolved.
12. Upon the confirmation of the assessment of benefits and damages the commissioners shall proceed to levy taxes, may borrow money, issue bonds or notes therefor and con-

struct and maintain the works provided for in the "plan of reclamation."

13. The engineer of the district will be the administrative officer in charge of the construction and maintenance of the works.

14. The commissioners upon proper proceedings may modify the "plan of reclamation" and may extend the boundaries of the district and tax any lands either in or outside of district which are benefited.

15. Owners of adjacent and contiguous lands may have their lands annexed to the district and the "plan of reclamation" may be modified so as to reclaim their land under proceedings similar those prescribed for the organization of the district.

IV. Special Features in the Uniform Law

In the author's draft for a uniform reclamation law features that are common, and well established by years of experience in many of the states, are used and an effort has been made to define with accuracy and certainty the steps necessary in the procedure. Of special interest, however, are some features which are new and a few others which are used in one or more states, but are not in common use. These features are explained in the following paragraphs:

A. Preliminary Proceedings and Engineer's Report—Upon the filing of a petition of 10 per cent or more of the landowners asking for the organization of a drainage district, the court will appoint an engineer to make a preliminary survey and report, with approximate estimates of cost, and no notice is required until the engineer's report is on file. (Sections 4 to 6.) This makes available the report of an engineer upon the question of the public necessity for the organization of the district and the feasibility of a plan at the first public hearing. The drainage law of at least one state (Arkansas) now follows a similar proceeding under the general drainage law.

In the majority of states the laws provide for a petition, which must be signed by some number of landowners, ranging from one owner to a majority of the landowners; also, when the petition is filed, for a public hearing upon the necessity for the organization of a district. All landowners may be heard, either for or against, but under this plan no information is available to the court except such as may be offered by the landowners themselves, or such engineers as they may individually employ for the purpose. There is obvious advantage in having at the first public hearing the benefit of the report and testimony of an engineer appointed by the court.

B. Preliminary Expenses—In most of the states where drainage laws have been effective for a number of years no satisfactory provision is made for meeting the preliminary expenses. In some states no provision is made for obtaining money until after the assessment of benefits has been established, and the interested landowners either must furnish money to pay expenses, or obtain the services of some engineer and attorney willing to carry the expense until the district shall have been organized. In other states a bond is required to be filed by the petitioners to cover the expense if the petition be dismissed, and the county board of supervisors, or other administrative officers of the county, are required to advance the money from county funds.

The Missouri law, and the laws of a number of states which have followed that form of procedure, provide for the levying of a preliminary tax of not to exceed 50c. per acre, to be used for the preliminary expenses. If the district is finally dissolved upon the hearing on the assessment of benefits and damages, no other tax is levied. The Mississippi law provides that the commissioners may borrow money on notes or other interest-bearing obligations for preliminary expense, and if the district is not organized they may levy a tax either upon an acre or ad valorem basis upon all the lands included within the petition. In all states, any expense incident to the organization of the district may be paid from the taxes upon the assessment of benefits, when approved.

In the author's draft of a uniform law the Mississippi method has been used, with the added provision that the notes or obligations for preliminary expense shall be drawn for a period of not more than three years, and that taxes shall be levied to meet the maturities of these obligations, whether the assessments of benefits shall have been completed or not (Section 7). This provision is made to meet a condition of delay which often occurs in the organization of a drainage district. Owing to opposition that develops or to the lapse of interest on the part of the petitioners, the final steps for levying taxes upon benefits and raising money are delayed in many cases for a number of years, but no adequate provision is made for the retirement of the obligations incurred, thus working a hardship on those who have furnished the services, and in some cases actually defeating the organization of the district.

C. Method of Taxation—The usual and almost universal method of taxation for land reclamation districts is by special assessment on the lands benefited. In Texas and Louisiana provision is made by separate laws in each state for the raising of funds for reclamation districts, either by general taxation or by special assessment. In some districts in these states the promoters have made use of both methods of taxation, but, so far as observed, there is no reclamation law in any state which provides for the combination of both methods under the same organization and proceeding.

Recognizing that there are some distinct benefits and equities which can be realized by the use of the ad valorem tax in reclamation districts, the uniform law is drawn so that either, or both, methods of taxation may be adopted in accordance with the wishes of the owners of land within the district, subject to the approval of the court having jurisdiction.

D. Number of Commissioners—There are usually three or five commissioners, supervisors or directors in the government board of the district. This number of officers is sufficient to give local representation in a district of any ordinary size. But it occurs occasionally that a district includes lands in a number of counties. In such cases, in order to provide local representation, a larger number of commissioners should be provided for. In the proposed uniform law the normal number of three is required, with one additional commissioner for each county when the district includes lands in more than one county, and the owners of land in each county are given the right to choose or nominate the commissioner who shall represent them (Section 8).

E. Engineer and Attorney as Officers—In most states the law provides for employment of an engineer and an attorney by the commissioners, but in a few states they are treated as officers of the district. This latter plan is embodied in the uniform law, as being both logical and desirable (Section 8).

F. Powers of the Commissioners—The powers of the

commissioners are set out in much more detail than is generally the case in a drainage law or irrigation law. In this respect the uniform law follows very closely to the provisions of the Ohio conservancy act (Section 10).

G. General Taxes Not To Be Increased—Landowners frequently feel that a great injustice is done by the state and county taxing officers who usually raise the assessed valuation of reclaimed land to correspond to the values which are created by the works, notwithstanding the fact that the owners must pay the amount of taxes necessary to create this increase in value. In other words, the owner is taxed to create a value and then is also taxed upon that value before he really acquires the ownership of it. In the uniform law it is provided that no increase of valuation shall be made for general, state and county taxation purposes due to benefits received from the reclamation, except as the reclamation taxes are paid by the owner (Section 15).

H. Abandonment of District Proceedings—It is one of the fundamental provisions of all reclamation laws that at some stage of the proceedings there shall be a finding by the court, or organizing authority, as to the relation between the benefits which will accrue from the carrying out of the "plan of reclamation" and the cost thereof. If the benefits will exceed the cost, the district will be organized, or the proceedings continued looking to organization, as the case may be. But if the benefits are less than the cost, then the proceedings must be dismissed and the district abandoned.

In the author's uniform law it is provided that if the court shall find that the benefits to be received from the "plan of reclamation" submitted by the commissioners would be less than the cost of reclamation, the matter shall be referred back to the commissioners by the court, whereupon the commissioners may revise their "plan of reclamation" and recast the corresponding benefits. It is provided, however, that if no benefits are approved by the court within five years from the time of the first filing of the "plan of reclamation" and assessment of benefits by the commissioners, the court shall then dismiss the proceedings and liquidate the affairs of the district.

I. Simplifying Procedure for Changes in Plans—Under the laws of many of the states even minor changes in plans require cumbersome court proceedings. In the uniform law an effort has been made to provide for minor changes in details of construction, which will not affect the benefits which the "plan of reclamation" will give, without invalidating the assessment or requiring a hearing by the court on such minor changes. Such changes would be made or ordered by the commissioners upon the recommendation of the engineer (Section 14).

J. Progressive Construction and Taxation—In the uniform law provision is made for taxing a portion of the land in a district for a portion of the work which will give special benefits to that land, and thereby make a progressive development and taxation. This obviates the necessity in many instances of organizing subdistricts for local improvements, and distributes the taxation temporarily where the benefits will apply until the "plan of reclamation" is completed and the entire area taxed, as provided in the assessment of benefits (Section 31).

In all of the reclamation laws it is contemplated that a definite "plan of reclamation" shall be made and completed with the least possible delay, and all lands taxed in accordance with the benefits based upon the completed plan. In the larger districts it often requires from three to six years to complete the work, so that the usual method of taxation places the burden upon some lands long before any benefits can be realized, while other lands receive full benefits much earlier.

K. Payments of Deferred Taxes—Under the laws of many states provision is made for the payment of taxes before bonds are issued, thereby relieving the owners of the lands for which taxes have been paid from further taxation for the retirement of such bonds. In Iowa provision is made also for the payment of the entire tax on any tract of land before the maturity of bonds and for calling in the bonds.

In the uniform law provision is made for the payment of deferred taxes, either before or after the bonds have been issued, and providing for retiring the bonds. The rights of the owner of the bonds are protected by providing a premium and advance payment of interest on all bonds that are retired in advance of their maturity (Section 40).

L. Old Districts Coming Under the Uniform Law—A provision in the uniform law makes it necessary for all active existing districts to come under the provision of this law whenever such districts desire to levy additional taxes or extend their works, but this provision safeguards all of the rights and obligations previously acquired by such districts. This method of bringing existing districts under the uniform law is suggested in preference to undertaking to redraft existing drainage laws so as to place all these districts under the provision of the uniform law. It is considered that this method of procedure will be more acceptable to those who may feel that they have vested rights under existing laws (Section 58).

M. Annexation of Outside Lands—Provision is made for annexation of lands by the commissioners when adjacent lands will be benefited by the works necessary to be constructed for the district. The district may also be extended by a petition signed by owners of land within the district, together with the owners of lands adjacent thereto, thus recognizing the community interest between the owners of land within and without the district (Section 20).

N. Tax for Maintenance of Works—Neglect of maintenance of drainage works is due frequently to lack of funds. In the proposed uniform law an annual tax is provided for the maintenance, operation and repair or enlargement of the works of the district (Section 33).

V. Digest of Proposed Law

The following digest of the proposed Uniform Drainage Law gives its principal features in general terms, section by section:

1. Definition of words and phrases used in the law.
2. *Purpose*—The purpose of a land reclamation district is general flood prevention, drainage and irrigation of agricultural lands and the protection, control and distribution of water supplies.
3. *Court*—The court having jurisdiction of the organization of a land reclamation district is defined and its duties are prescribed.
4. *Petition*—Ten per cent, or more, of the owners of any contiguous body of land may petition for the organization of a land reclamation district.
5. *Engineer Appointed*—When a petition is filed, the court is to appoint an engineer to make a preliminary survey, report the boundaries which the district should

have, describe the proposed reclamation works and give an approximate estimate of cost.

6. *Public Hearing*—When the engineer's report is filed, the clerk of the court is to give notice to all persons whose property will be affected, and the court will order a hearing. If it should be found at such hearing that one-third of the owners owning half of the land, or half of the owners owning one-third of the land, have petitioned for the organization of the reclamation district, the court will organize the district without further consideration. Conversely, if objections should be filed signed by one-third of the owners representing a majority of the land, or a majority of the owners representing one-third of the land, then the court will dismiss the petition without further consideration and will levy a tax on all the lands covered by the petition to pay the expenses incurred in connection with the proceedings.

7. *Preliminary Expense*—Money shall be provided for the preliminary expense by note issued by the court, which shall be paid from taxes against the land proposed to be organized into a drainage district, or from the taxes of the district after it has been organized.

8. *Commissioners*—The court shall appoint three commissioners, who may be selected by the owners, and if the district includes lands in more than one county there shall be an additional commissioner for each county so that there may be local representation. The commissioners when first appointed will be for one, two or three years, respectively, and their successors will be appointed by the court upon a petition of a majority of owners of land in such district. When the commissioners are appointed and have qualified, they shall organize, elect a president from their own number, a secretary who may or may not be a commissioner, and a treasurer, who cannot be a commissioner. They shall also elect as officers of the district a district engineer and an attorney, and shall determine the salaries of the respective officers.

9. *Sureties*—Sureties shall be furnished by the officers of the district, and by all contractors.

10. *Commissioners' Authority*—Commissioners are given entire control over the appointment of officers, the preparation of plans and the construction and maintenance of the work; also the authority to levy and collect taxes in accordance with the decree of the court.

11. *Compensation*— The compensation of the commissioners shall be $5 per day for time actually engaged, and they shall be reimbursed for actual and reasonable traveling and living expenses while engaged upon the work.

12. *Liability of Officers for Damages*—The commissioners and other officers of the district shall not be liable to any landowner for any damages which may occur from entering upon the property while in the pursuit of their respective duties.

13. *Liability of Contractors for Damages*—Contractors and their employees shall have the right to pass over the land in the district, and shall not be liable for any damages to any private property when acting within their duties and upon the right-of-way provided by the district, but may be liable for damages to property not controlled by the district.

14. *Plan of Reclamation*—The district engineer shall prepare a "plan of reclamation" for the approval of the board of commissioners. The "plan of reclamation" may be amended or changed. When such change is fundamental, or changes the relation of the benefits to any tract of land, a hearing shall be given before the court for readjustment of the benefits and damages. But modifications of details which do not change the effect of the plan may be made by the commissioners upon the recommendation of the engineer, without submitting the same to the court for approval.

15. *Assessment Roll*—The commissioners shall appraise the benefits and damages and prepare assessment roll for the approval of the court, and when the assessment of benefits has been conformed by the court it shall be a basis for taxation for the raising of revenues for the construction and maintenance of the work and for the payment of obligations of the district.

16. *Assessments* — Benefits may be assessed to lands which have not been included in the original assessment when such lands are or will be benefited by the works of the district, or additional benefits may be assessed over the entire district when the amount of such benefits is not sufficient to pay the "cost of reclamation."

17. *Hearing of Objections*—When the "plan of reclamation" and the commissioners' assessment of benefits and damages are filed, notice shall be given to all interested landowners of the date when the court will hear objections to the assessment.

18. *Decision of Court*—The court shall hear all objections that may be made to the assessment and shall call a jury for the determination of damages which cannot be adjusted by the commissioners. The court shall determine if the benefits in the aggregate will equal or exceed the cost of construction, which includes all damages and other expenses and, if so, shall order the confirmation of the assessment. But if the cost will be more than the benefits the court shall refuse to confirm the assessment and refer the matter back to the commissioners for further action. If no assessment is confirmed within a period of five years the court shall dismiss the proceedings and levy a tax to pay all obligations of the district.

19. *Correction of Errors*—Any errors or omissions not in proceedings may be corrected without invalidating the proceedings as to those parties not affected by the errors.

20. *Annexation of Other Lands*—Any body of land contiguous to a land reclamation district may be annexed thereto upon petition of 10 per cent of the owners thereof, and the proceedings for the annexation are similar to those for the organization of a drainage district.

21. *Sub-Districts*—Sub-districts, or an independent district, may be organized in any Land Reclamation district for construction of needed improvements of a local character when not provided for in the existing "plan of reclamation." The organization of the sub-district follows the same general method as the organization of a land reclamation district, except that the officers of the existing district shall be ex-officio officers of the sub-district.

22. *Taxing in More Than One District*—Land may be taxed in more than one district to the extent that benefits are furnished by the "plan of reclamation" of each district.

23. *Consolidation of Districts* — Two or more land reclamation districts may be consolidated when 10 per cent or more of the owners of land in such districts petition therefor, the proceedings to be in all respects similar to those for the organization of a land reclamation district.

24. *Connections with District Works*—Any person owning land may connect the same with the works of any land reclamation district in which such land is located, under the rules and regulations established by the commissioners. If any persons connect works of any kind from lands outside the district with the works of such district, they shall be considered to have voluntarily annexed such land or property to such district, and such land or property shall thereafter be subject to taxation, as if originally included in the district.

25. *Appeals*—Appeals may be made from the decisions of the court on the matter of damages, but no appeal shall be taken from the decision of the court on the matter of benefits. The appeal shall not act as a supersedeas, but the commissioners may proceed by depositing the amount of damages allowed by the lower court and take the property.

26. *Change of Venue* — No change of venue shall be taken, except when the judge of the court in which the petition is filed is disqualified under the provisions of the general statute relating to changes of venue in civil cases. Whenever such disqualification occurs, the judge of such court shall call some other judge to sit in his place.

27. *District as a Corporation*—A land reclamation district shall continue a political sub-division of the state as a municipal corporation, unless dissolved by the court upon the petition of two-thirds of the owners of real property, owning not less than two-thirds of the area of such districts.

28. *Preliminary Taxes*—Preliminary taxes shall be levied

to meet the obligations of the district and preliminary expenses when such obligations mature, without waiting for the collection of taxes from the establishment of benefits. The preliminary obligations of the district may run for a period of not to exceed three years from the date of their issue.

29. *Taxes for Cost of Works*—After the confirmation of the assessment of benefits, the commissioners shall levy taxes for the "cost of reclamation" either as a whole or in installments. The taxes or installments thereof shall draw interest at the rate of 6 per cent per annum, payable annually, until such taxes are paid.

30. *Bonds*—The commissioners may divide the taxes into installments and sell bonds in anticipation of the collection of the taxes to secure the necessary funds to pay the "cost of reclamation."

31. *Pro-rating of Taxes*—When the construction of the work will require such a length of time that some portions of the district may obtain benefits long before other portions will be reached, the taxes may be pro-rated from year to year by the commissioners, with the approval of the court, in relation to the benefits which will result from the work being done. The commissioners may outline a program of progressive construction and taxation to equitably distribute the collection of taxes in relation to the benefits as they may accrue to the lands of the district. When work under the "plan of reclamation" is finally completed the taxes shall be so adjusted that each tract of land shall have been taxed in the ratio of the benefits originally established by the court.

32. *Additional Taxes*—The commissioners may make additional tax levies from time to time to pay the "cost of reclamation" or to meet the obligations of the district. But no property shall be taxed in excess of its benefits or to an amount which would be greater than its ratio of benefits to other lands.

33. *Maintenance Taxes*—The maintenances taxes may be levied from year to year not to exceed 10 per cent of the amount previously expended from the "reclamation funds."

34. *Tax Roll*—The commissioners shall prepare a tax roll each year providing funds for the payment of bonds and other obligations which mature, and the interest thereon, and also for maintenance taxes.

35. *Taxes as Liens*—Taxes levied upon lands and other property become liens and collectable from and after the date that general, state and county taxes are due.

36. *Prepayment of Taxes*—Any person may pay the full amount of his reclamation tax before the bonds are issued and thereafter be exempt from taxation for the payment of such bond issue and the interest thereon.

37. *Tax Collection*—The commissioners shall provide for the collection of taxes by delivering a tax roll to the county collector and require the collector to furnish adequate bonds.

38. *Tax Penalties*—Taxes remaining unpaid on Dec. 31 of any year shall thereafter be delinquent and shall bear a penalty of 2 per cent per month from the date of delinquency and until paid.

39. *Tax on Subdivision*—The collector of taxes may receive the taxes on a portion of a tract which has been subdivided or sold only when the deed of transfer shows the relative amount of tax which is to attach to each portion of the tract so divided and approved by the commissioners.

40. *Deferred Taxes*—Any landowner may pay his deferred taxes in full and have the amount of bond which such taxes represent retired by paying a premium, as provided in the form of the bond.

41. *Delinquent Taxes*—When taxes are delinquent it shall be the duty of the commissioners to institute a suit for their collection by the sale of the property.

42. *Payment by Collector*—Any collector who fails to promptly turn over the taxes collected shall be liable to a penalty of 10 per cent payable to the district.

43. *Fees of Collectors*—The county collector shall retain half of 1 per cent (0.5 per cent) of all taxes collected by him before taxes become delinquent, and 1 per cent of delinquent taxes and penalties collected by him.

44. *Collection of Obligations*—The owner of any warrant, bond or other obligation of the district which is past due shall have the right to bring suite to enforce collection of such obligation.

45. *Bonds for Taxes*—The commissioners may issue and sell bonds in anticipation of the collection of deferred taxes, which bonds, together with other interest bearing obligations of the district, shall not exceed in the aggregate 90 per cent of the total amount of benefits assessed against real property and the ad valorem tax authorized. The commissioners shall set aside a portion of the benefits and ad valorem tax equal to 10 per cent more than the bonds issued as a basis for their retirement. A record of all bonds shall be kept by the secretary.

46. *Bond Values*—Bonds shall be issued in multiples of $100. They shall mature at annual intervals for a period of not more than 25 years, beginning not later than five years after the date of issue. Bonds shall bear interest not exceeding 6 per cent per annum, payable semi-annually.

47. *Record of Bonds*—The treasurer of the district shall keep a record of all bonds.

48. *Sale of Bonds*—The commissioners may sell the bonds by negotiation or by advertising in any market at not less than 95 per cent of the par value and accrued interest. They may pay the cost of lithographing and the necessary legal and brokerage expense for selling the bonds.

49. *Deposit of Funds*—All funds of the district, including moneys received from the sale of bonds, shall be placed in such depositories as the commissioners may designate, and such depositories shall pay into the treasurry of the district interest on the daily balances.

50. *Payments on Bonds*—Principal and interest of the bonds shall be paid at a designated place. Bonds and coupons not paid at maturity shall bear interest after maturity until paid, or funds deposited at the place of payment. Any surplus remaining from taxes collected for the payment of interest and bonds of any one year may be applied by the commissioners to any other legal obligation.

51. *Retirement of Bonds*—Commissioners may retire bonds before maturity by giving notice at the place of payment, and paying into the depository designated for that purpose for the retirement of the designated bonds, a sum equal to the par value, plus the premium prescribed in the face of the bonds as a basis of retirement.

52. *Unpaid Warrants*—When any warrant drawn by the commissioners is presented to the treasurer and not paid for lack of funds, the treasurer shall endorse on the back of the warrant the fact that thereafter such warrant shall draw interest at the rate of 6 per cent per annum until paid, or until there is money in the hands of the treasurer to pay the warrant.

53. *Passage of Bridges*—The equipment used by the commissioners of the district or by any contractor in the construction of the district works may pass through any bridge, grade or railroad or other property crossing the right-of-way of the district, and the district shall reimburse the owner the actual cost of the removal and replacement of the structure. Any owner of such structure who delays the work of the district shall be liable for damages due to the delay.

54. *Bridges*—All railroads and other corporations, private or municipal, or the State or Federal Government, when maintaining bridges or other obstructions crossing a natural or artificial watercourse, must construct and maintain the same to conform to the "plan of reclamation" and must remove any such structure which would interfere with the purpose of the reclamation district. The expense of erecting, changing or maintaining such structure shall be borne by the corporation, or person using the same, except where the "plan of reclamation" required the construction of bridges or other structures in locations where no such bridge or structure is maintained, in which case the court will require the district to pay damages. The owner of any such bridge or structure shall have the right of hearing before the court on the necessity of any changes.

55. *Damages to Works*—All persons or corporations are liable to damages and penalties for injury done to the works of the district.

56. *Water Rates*—The commissioners may establish rates for the use of water which may be provided for or supplied by the district, and the rates so established shall be subject to review by the court having jurisdiction over the district.

57. *Legal Forms*—Forms should be prepared to conform to the usual legal requirements for similar proceedings in the states where the uniform law may be adopted.

58. *Relation to Other Laws and Existing Districts*—No other drainage, irrigation or reclamation law will be repealed, but the enactment of this law provides an alternative system of procedure, complete in itself and independent of other laws.

Graphics Applied to Economic Location of Buildings

How "Cost-Contours" Visualize Changes in Cost Effected by Shifting Power House Site on Side-Hill Location

By Charles P. Dunn
Seattle, Wash.

A GRAPHICAL method for determining the most economical location for a power house is developed by the writer in the following example to illustrate his method of applying graphical principles to the solution of economic problems in engineering design. As will be shown, this method enables the engineer to see clearly the effect on construction cost of shifting the building within the limits of the area under consideration. This in turn makes it easy for him to determine whether net economies may be effected by changes in site looking to convenience of railway access, location of construction plant and material yard or cost of real estate, as the excess cost of construction at a given location over the lowest attainable cost can be taken from the graphs.

Determination of Power House Site.—Let the problem be to determine the most economical location for a power house, 85 x 170 ft., to house four units. Fig. 1 shows a contour map of the site with bedrock contours dotted. It is assumed that the headworks and conduit have already been located and that conditions are such that the length of conduit and penstocks will not be

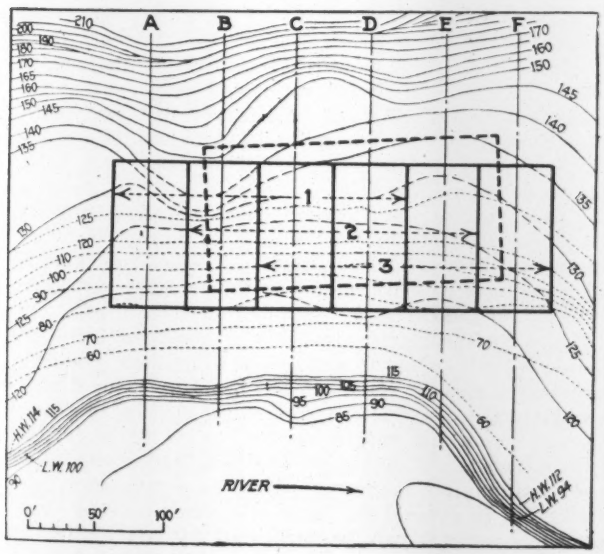


FIG. 1. PLAN OF SITE SHOWING TENTATIVE LOCATIONS

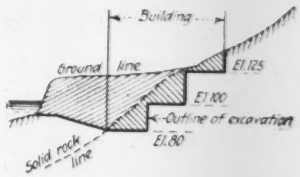


FIG. 2. SECTION AT CENTER LINE A

changed appreciably by shifting up or down stream.

Consider a series of tentative locations paralleling and overlapping each other and marked 1, 2 and 3 on Fig. 1. The intervals between these tentative locations, which we will call "base" locations, are made equal to one-quarter of the length of the building.

For the purpose of estimating the change in cost that results from change of location, the building is divided

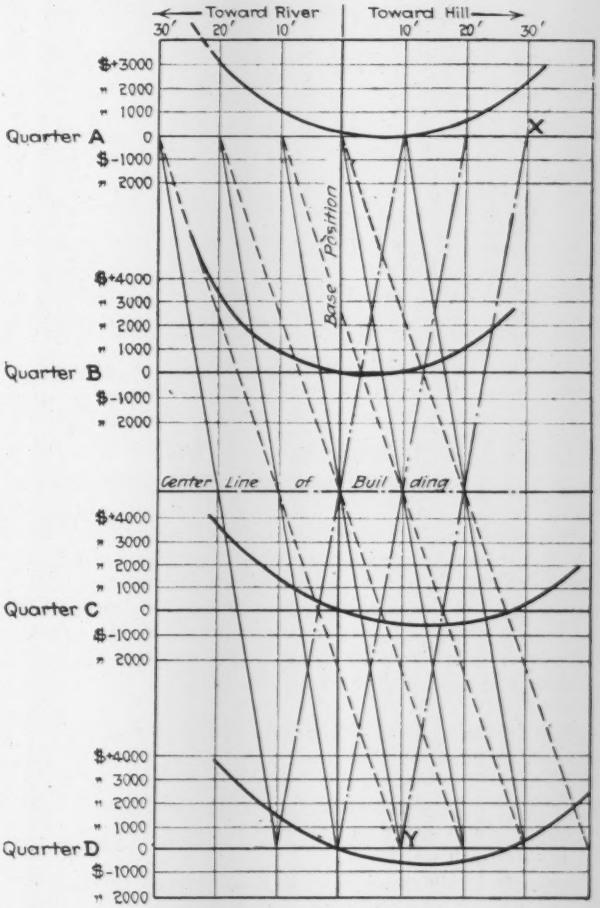


FIG. 3. VARIATION IN COST WITH MOVEMENT TOWARD AND AWAY FROM RIVER

into four units and the lines *A*, *B*, *C*, *D*, *E* and *F* are drawn, each through the center of one quarter of the building. For the building in base position No. 1 we are concerned with units *A*, *B*, *C*, and *D* only.

Cross-sections at *A*, *B*, *C* and *D* are then drawn as shown in Fig. 2. The lines of excavation and foundation concrete are drawn on these sections in several positions, one in the base position (Fig. 2) and others, not shown, in positions nearer to the river and nearer to the hill. Although excavation for a power station is not uniform throughout its length, reasonable accuracy may be attained by using an average section.

The variation in the cost of each quarter of the building as it is assumed to move along its center line *A*, *B*, *C* or *D* is now computed. Only the differences in cost

are computed, no account being taken of the items that do not vary.

These differences in cost are platted in the curves shown in Fig. 3, each curve representing the variation in cost of one-quarter of the building as it moves toward or away from the river. For example: the cost of that quarter of the building centered on line *A* is increased by $3,000 if it be moved from the base position 20 ft. toward the river. The lines *A*, *B*, *C*, and *D* at value $0 in Fig. 3 are spaced equidistant (as they are in the plan), and the center line of the building is drawn midway between *B* and *C*.

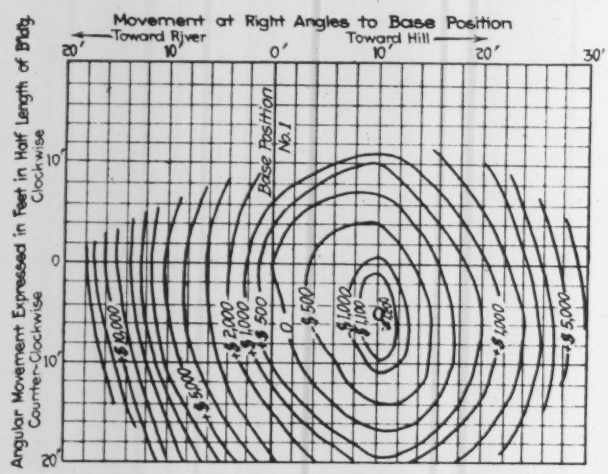


FIG. 4. CONTOURS SHOWING VARIATION IN COST WITH RESPECT TO BASE POSITION No. 1

It is clear that the most economical site for the building with respect to base position No. 1 and with no movement up or down stream would be defined by a straight line intersecting the lines *A*, *B*, *C* and *D* in Fig. 3 at points opposite to the minimum points of the curves, but as a line so determined would rarely be straight, it is evident that a compromise must be made. The most economical compromise may be determined graphically.

Each of the vertical and sloping lines in Fig. 3 represents an assumed position of the building. The line *XY*, for example, represents the building moved bodily 20 ft. from the base position toward the hill and turned clockwise about its center through an angle of 10 ft. in half the length of the building. Turning the building at an angle to the base position introduces a small error the amount of which depends on the amount of angular movement, and after a preliminary approximation the engineer may judge whether a second determination is necessary.

The cost of the building in this position is estimated as follows:

For ½ bldg. on line *A*, $2300 more than in base position
" " " " " *B*, 1800 more than in base position
" " " " " *C*, 600 more than in base position
" " " " " *D*, 600 more than in base position

The algebraic sum of the above gives a cost for the whole building on the axis *XY* $2,900 greater than that estimated for the original base position No. 1. This establishes one point on the "dollar-contour" map (Fig. 4). Each line across the curves on Fig. 3 supplies the data for a similar point on Fig. 4 and enough of these points are computed to determine the contour of minimum cost.

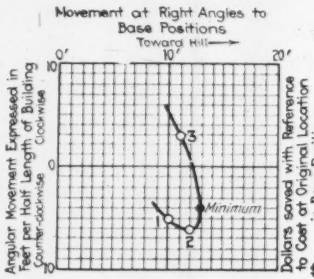


FIG. 5. CURVE OF MINIMUM COST AS BASE POSITION IS VARIED

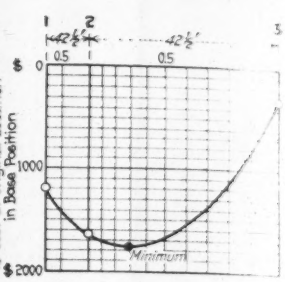


FIG. 6. PROFILE OF CURVE SHOWN IN FIG. 5

So far we have considered only the variants of position No. 1, moving to and from the river at varying angles but with no movement up or down stream. A similar study of positions No. 2 and No. 3 completes this phase of the investigation. Sections *B*, *C*, *D* and *E* are used for position No. 2 and sections *C*, *D*, *E* and *F* for position No. 3.

Adjustment and Use of Cost-Contour Map.—To reduce all costs to the same datum, the dollar contours for position No. 2 are corrected by the amount the quarter building at *E* costs less than the quarter building at *A* in the base position ($250), and like corrections are made to the contours for position No. 3 by the amount the one-half building *E* plus *F* in base position costs more than the one-half building *A* plus *B* in base position ($1,430).

The minimum points on No. 2 and No. 3 contour maps (not shown) show $1,650 and $320 respectively lower cost than in the base positions. The three minimum points obtained at the base locations No. 1, No. 2 and No. 3 are now transferred to Fig. 5, and a curve passed through them. The profile of this curve is drawn in Fig. 6. The actual distances between base positions No. 1 and No. 2, and between No. 2 and No. 3 are identical (42½ ft.) but since these distances are distorted in Fig. 5, a correspondingly distorted horizontal scale must be used in Fig. 6.

The profile in Fig. 6 shows the most economical location to be three-tenths of the distance from base position No. 2 toward No. 3, which, when transferred to the curve on Fig. 5 gives a location 13 ft. from No. 2 toward No. 3, 13 ft. toward the hill from the line of base positions, and turned counter-clockwise about the center through an angle of four feet in half the length, at which position the cost will be $1,760 less than in the original base position No. 1. This final location is shown dotted in Fig. 1.

Every engineer is familiar with the advantages of graphical methods in the solution of purely technical problems. Many, however, have overlooked the value of such methods as here applied to the economic problems involved in the design of engineering structures.

The act of bringing together in a graph the facts and opinions that pertain to a complicated problem gives the engineer a clearer vision of the problem, helps him to eliminate the personal equation and leads him to a solution in which due weight has been given to every pertinent factor. In rare cases the ideas to be considered are so intangible that they cannot be expressed graphically, but in general the value of a man's opinion on an economic subject can be measured by his ability to express it in a graph.

Expansion and Overturning Causes Damage to Concrete Bridge

By Harlan H. Edwards
City Engineer, Danville, Ill.

DECK expansion of a long concrete bridge in Danville, Ill., with inadequate provision for expansion, water trapped behind abutments and poor concrete were the main causes of incipient failure last fall. It is another example of the lightness with which many public officials regard the importance of adequate and competent engineering control of the construction of municipal structures. Investigations made during the progress of the repairs to the structure disclosed conditions which showed that certain engineering features of the structure as originally planned were neglected or changed and that the character of the concrete work was not of the high class that it should have been.

The Mill St. bridge is a nine-span reinforced-concrete arch viaduct, designed for highway use, having the arch rings of the end spans resting on the abutment walls of the approaches. It was built in 1915 at a cost of about $85,000. As early as three years after the completion of the structure, cracks were noticed in the spandrel columns and arch rings of the east end span, which increased in size and number until action this past summer was imperative to prevent failure of the entire span and probably with it the remaining eight spans of the bridge.

This investigaton led to repairs and additional construction, while the conditions found in the later work corroborated the engineer's assumption that failure in the span was largely due to the fact that the expansion of the deck was inadequately provided for, and that this was assisted by a double action of sliding and overturning of the abutment wall. As shown in Fig. 2, a crack had developed between the wingwall of the abutment and the approach wall, measuring 1¼ in. at the top. The movement of the deck at the face of the abutment was 2 in., indicating about ¾-in. movement due to expansion.

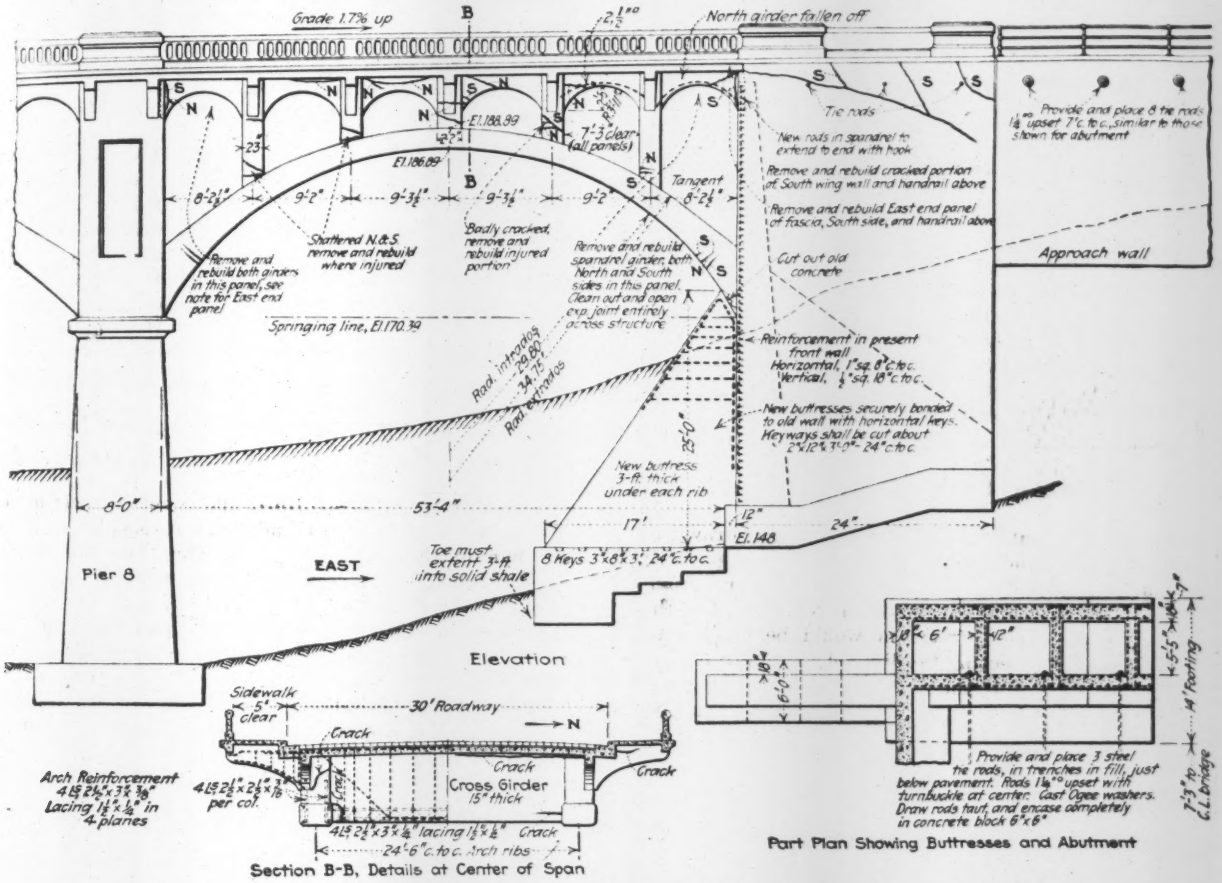

Grade 1.7% up
North girder fallen off
Tie rods
Provide and place 8 tie rods 1⅛" upset 7'-0" c. to c., similar to those shown for abutment
New rods in spandrel to extend to end with hook
Remove and rebuild cracked portion of South wing wall and handrail above
Remove and rebuild East end panel of fascia, South side, and handrail above
Approach wall
Cut out old concrete
Remove and rebuild both girders in this panel, see note for East end panel
Shattered N. & S. remove and rebuild where injured
Badly cracked, remove and rebuild injured portion
Remove and rebuild spandrel girder, both North and South sides in this panel. Clean out and open exp. joint entirely across structure
Springing line, El. 170.39
Reinforcement in present front wall Horizontal, 1" sq. 8" c. to c. Vertical, ¾" sq. 18" c. to c.
New buttresses securely bonded to old wall with horizontal keys. Keyways shall be cut about 2"x12" 3'-0" c. to c. 24" c. to c.
New buttress 3-ft. thick under each rib
Toe must extend 3-ft. into solid shale
8 Keys 3"x8"x3", 24" c. to c.
Pier 8
EAST
Elevation
Sidewalk 5' clear
30' Roadway
Crack
Cross Girder 15" thick
Arch Reinforcement 4 L's 2½"x2½"x⅜" Lacing 1½"x⅛" in 4 planes
4 L's 2½"x2½"x⅜" per col.
4 L's 2½"x3½"x⅛" lacing 1½"x⅛"
24'-6" c. to c. Arch ribs
Section B-B, Details at Center of Span
Provide and place 3 steel tie rods, in trenches in fill, just below pavement. Rods 1⅛" upset with turnbuckle at center. Cast Ogee washers. Draw rods taut, and encase completely in concrete block 6"x6"
Part Plan Showing Buttresses and Abutment

FIG. 1. DETAILS OF DAMAGE TO DANVILLE STREET BRIDGE, AND REPAIR METHODS

The wing walls were of a cellular type, the wells of which had not been filled, thus lightening the wall considerably. No provision for drainage of seepage water from behind the walls had been made, which resulted in a spreading of the walls of about 3½ in. at the ends, since considerable water was found retained. The fact that the abutment walls were ½ in. out of plumb, that the crack of the wingwalls at the approach wall was larger at the top than the bottom, would indicate an overturning movement. The character of the foundation seemed to show that apparently there had been no attempt to bed the bottom of the footing evenly in the shale. Instead, the bed was inclined and part of the footing was founded on coal, 3 ft. thick, immediately above the shale, thus permitting a sliding action.

As shown in Fig. 1, the arch rings were cracked in several places while the crown of the arch was built with a 9-in. greater rise than called for in the design.

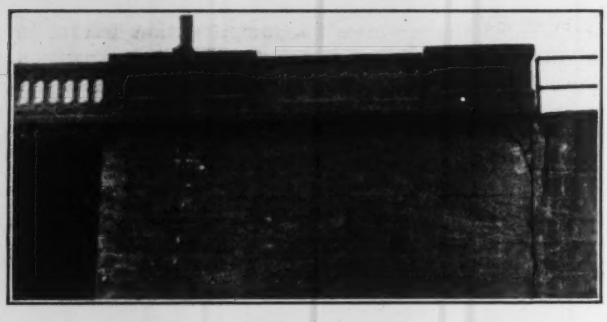


FIG. 2. CRACK BETWEEN WINGWALL (ON RIGHT) AND ABUTMENT

The roadway at the curb in the center of the span was humped 1½ in., which probably is the measure of the actual rise of the crown of the arch due to the shortening of the span.

The failure of the spandrel column, as shown in Fig. 2 and more strikingly in Fig. 3, was due to compression, though they were all out of plumb, due to a thrusting of the arch to the west and an expansion movement of the deck to the east. In warm weather all expansion joints were tight, and in the case of the expansion joints of the span in question, there was apparently nothing built but an ordinary construction joint with no attempt at allowing a space for movement as the span elongated with warm weather.

The concrete of all but the rings was noticeably weak

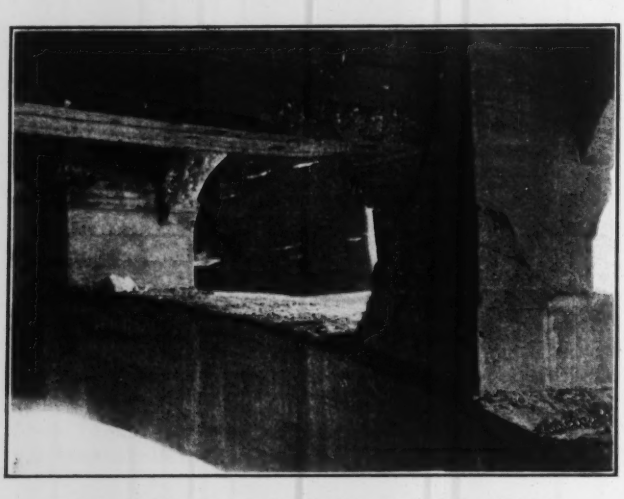


FIG. 3. FAILURE OF SPANDREL COLUMN DUE TO ARCH THRUST

and faulty and most of it had received a generous wash-coat of grout to cover up its defects. Care was not used in depositing the concrete in the forms to prevent honeycomb, while the columns especially were lacking in mortar, due either to a mix lean in sand and cement, or more probably due to separation while chuting into place.

The details of the repairs were carried out under the direction of W. C. Reynolds and supervision of S. G. Gould, of Harrington, Howard and Ash, consulting engineers of Kansas City. The abutment wall was stabilized by the construction of large concrete buttresses as shown on Fig. 2. The shattered portions of the spandrel columns were replaced, supporting the deck on timbers which rested on the arch rings. The broken portions of the roadway and fascia beams and the sheared upper portion of the wing walls were also completely replaced, while seven steel-and-concrete ties were placed across the wing walls and approach walls to arrest further spreading. Future expansion was provided for by opening new expansion joints at each end of the span. Drainage holes were provided in the abutment wall to insure future drainage of this part of the structure. The empty wells of the cellular wing walls of the abutment were completely filled and a new substantial sidewalk laid over them.

New Jersey Water Tax Finances State Board

A TAX of $23,262 was levied against 27 water-supply systems of New Jersey by the Department of Conservation and Development of that state for "excess diversion of water" during 1921. The rate of this levy was $1 per million gallons on all water diverted in excess of a certain free allowance granted by the legislative act of 1907 creating the State Water Supply Commission (one of the predecessors of the Department of Conservation and Development). The free allowance is the amount of water legally diverted in the year 1917 by any water-works system for municipal supply, except that there is no charge on diversions totaling less than 100 gal. per capita.

The 27 water systems on which this tax or license charge was levied supply a total population of 1,801,500. The charge amounts to 1.3c. a year per capita.

The total license charges for 1921 were $5,543 less than for 1920, when some thirty systems diverted more than their free allowance, and $1,288 less than the average charge for the last five years. The department named above attributes the decrease in consumption to "the business depression."

This license charge on excess water diversion finances the water-supply work of the Department of Conservation and Development, which includes investigations of new water-supply projects besides stream gagings and inspection of dams. A total of 21 stream gaging stations are maintained and one will be added this spring. The report on the water-supply situation in the New Jersey metropolitan district by Hazen, Whipple and Fuller, abstracted in *Engineering News-Record*, March 16, p. 430, was paid for from the excess diversion water tax.

Those interested in further particulars of this license charge for excess water diversion may find particulars in a small pamphlet issued by the Department of Conservation and Development, Trenton, N. J., entitled "Laws and Rules Relating to Public Water Supplies and the Erection of Dams."

Across-Road Conduits Built with Pavement

Across-road pipe and wire conduits under new paved roads are required by the New Jersey highway department where a future demand for gas or electric service appears probable. The conduits are located at reasonable intervals generally determined in consultation with local public service corporation officials. They are built when the pavement is built and are then closed off until such time as service requires the street to be crossed, when they are made ready for use.

Flood Conditions and Flood-Protection Problems—II

Final Extracts From Papers Read at Dayton Meeting of American Society of Civil Engineers Outlining Main Elements of Situation in United States and Canada

Mississippi River Control by Levees

By J. A. Ockerson
Consulting Engineer; Member of Mississippi River Commission, St. Louis

The Mississippi drainage basin covers an area of 1,240,050 sq.mi.; the eastern extremity extends into western New York, about south of Buffalo, the western extremity into Montana, west of Butte, the northern into western Canada, 70 miles north of the boundary line, and the southern extremity to the Gulf of Mexico. Besides all or parts of thirty states, this drainage basin includes 20,000 sq.mi. in Canada. It covers 1,822 mi. in longitude and 1,449 mi. in latitude, or 41 per cent of the United States proper.

This great basin is divided into several tributary basins as shown in table, in which is also tabulated the mean annual rainfall in each, for a period of 25 years (U. S. Weather Bureau, 1897).

Name of Basin	Area, Square Miles	Percentage of Whole	Average Annual Rainfall, In.
Ohio	201,700	16	44.2
Upper Mississippi	165,900	13	31.9
Missouri	527,150	43	19.4
Arkansas	186,300	15	29.6
Red	90,000	7	39.1
Central	69,000	6	51.4
Total	1,240,000	100	29.8

The Mississippi River Commission, created in 1879, was charged with developing and executing plans for the improvement of the Mississippi River, to "correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River, improve and give safety and ease to the navigation thereof, prevent destructive floods, promote and facilitate commerce, trade, and the postal service."

Methods of Control — The advocates of flood control for this district were divided into three camps, namely those who favored reservoirs, those who favored outlets, only; and those who regarded the experience of about two centuries with levees for partial flood control as sufficient to justify the use of them for complete control. Others asserted that the floods could not be controlled and that no attempt should be made to curb them, but that mounds should be built for the occupation by the people and their live stock while the lands were flooded. The digging of another river channel from Ohio to the Gulf equal to that of the Mississippi was also urged on Congress.

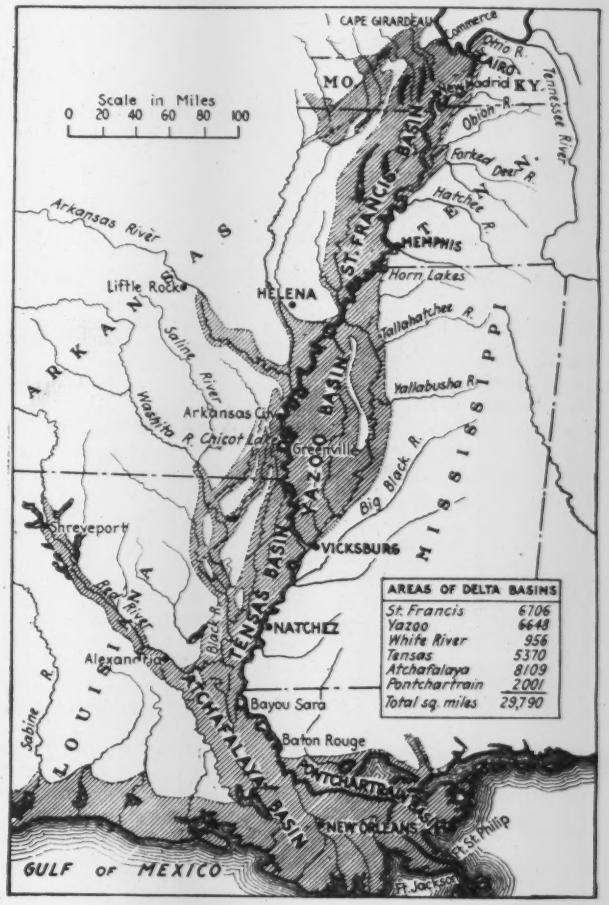
The commission undertook a study of all these plans for flood control and concluded that reservoirs to prevent floods along the lower Mississippi were impracticable, owing to the great number and the size required and to the lack of suitable sites.

The effect of outlets was given careful consideration in the study of the action of existing outlets. There can be no outlets above the mouth of Red River that would relieve the river of flood water without returning it again at a lower point; therefore the major portion of the delta basin would be overflowed before an escape could be reached. Extended observations and many measurements also showed that the reduction of volume by means of secondary channels of an alluvial stream, flowing in a bed of its own formation will reduce the capacity of the main stream and ultimately will result in an increased flood height at and near the point of diversion. Therefore, the conclusion was reached that ultimately all outlets above the Head of the Passes should be closed.

The river at bank-full stage will carry about one-half its maximum discharge, which is about 2,000,000 sec.-ft. at the upper end of the delta. The oscillation of stage between extreme high and low water varies with the locality, up to 60 ft. at Arkansas City and Vicksburg.

Levee Protection — Construction of levees for flood control began at New Orleans in 1717, and by 1828 they had been extended on the left bank to Baton Rouge and on the right bank to the mouth of the Red River. As the river banks became settled, levees were built, and by 1860 all the great delta basins had some measure of flood protection in detached lengths of levee. At that time, the levees averaged about 4 ft. in height, whereas today they average about 18 ft. high.

In 1850 the Federal Government granted to the several states along the Mississippi all the unsold swamp and



FLOOD AREAS OF MISSISSIPPI DELTA

overflowed lands below the Ohio, the purpose being to provide a fund for reclaiming the inundated land, and this gave a decided impetus to the construction of levees. However, even up to 1882, when the Federal Government again came to their relief, through the Mississippi River Commission, flood control by the use of levees did not meet with universal approval owing to the many disastrous failures (712 breaks in the floods of 1881-82-83), although competent engineering boards had repeatedly declared that flood control could only be realized by the use of adequate levees. It was claimed that the construction of levees caused the bed of the river to raise, and consequently they would defeat their own purpose. Extended investigations

established the fact that there has been no progressive elevation of the bed of the river due to levee construction. On the contrary, the latest comparison shows that there is a well-defined tendency toward a cross-section of greater capacity, including a lowering of the bed of the river. Levees were adopted by the commission.

Prior to the construction of levees, the floods of the river covered a width of 60 miles. The floods, laden with sediment, overflowed the channel and deposited the major portion of their load near the river banks, and this in time developed a land slope away from the river of from 3 to 15 ft. per mile. The natural drainage therefore is inland toward the highlands, where it enters tributary streams which in turn empty into the Mississippi at the lower ends of the several basins.

At present, the levees are completed to standard grade and section for about 500 miles. The entire length of the controlling levee line is to a grade that will withstand normal floods, and the practice is to complete the levee to standard grade and section, from the upstream limits of the respective basins, as the work progresses.

Present Standard — The standard levee section adopted has a crown width of 8 ft. at 3 ft. above the highest flood stage, and has side slopes of 1 on 3, supplemented on the land side by banquettes 20 ft. wide for levees from 10 to 13 ft. high, 30 ft. wide for levees 13 to 16 ft. high, and 40 ft. wide for levees more than 16 ft. high, the tops of the banquettes being from 5 to 8 ft. below the tops of the levees. The shrinkage allowance is 15 per cent of the net fill for scraper work, 20 per cent for wagon work, and 25 per cent for dragline and other machine scrapers. The earth is taken from a borrow-pit, usually on the river side of the levee, leaving a berm 40 ft. in width. The pit, beginning at the berm, is 3 ft. deep and from that point outward may be deepened on a slope of 1 on 50 and excavated so as to afford thorough drainage at the back of the pit.

After completion the levees are sodded with Bermuda grass, which affords excellent protection from erosion by rain. Where levees are exposed to wave action, a layer of concrete about 4 in. thick or a board protection is used to break the force of the waves. Severe tropical Gulf storms below New Orleans make necessary substantial protection of the levees from wave action.

The extent of saturation in a levee depends on the character of the soil of which it is built, the length of time it is exposed to the flood, and the depth of water against it. Experiments show that the hydraulic gradient, or the line between the wet and the dry earth in a levee, has a slope of about 1 on 5. To make the levee secure this line should fall well within the base, hence the necessity of reinforcing the levee with a banquette.

In many places, active bank erosion has made it necessary to rebuild the lines of levee several times; particularly is this true of the earlier work in which the levees were placed too near the river bank. The present practice is to locate the levee so that it will be safe from normal bank errosion for at least 20 years.

The remedy for bank erosion is the revetment, which has been developed by the engineers of the Mississippi River Commission. There are three general types, namely, willow mattresses, articulate concrete mats, and solid concrete mats. The articulated concrete-block system was developed by the engineers of the Vicksburg District. The blocks or mat units are 3 in. thick, 11½ in. wide and 3 ft. 11 in. long, reinforced with 12-in. wire mesh. This type has an advantage in that the block units can be prepared in advance, when river conditions are unfavorable for placing the mats. Solid concrete mats, developed in the Memphis District, are reinforced-concrete sheets 50 by 150 ft. by 3 in. thick, sunk in a semi-plastic state from supporting trusses, by pulling the launching barge out from under. It should be stated, however, that this type of mat has not yet been tested to such extent as to develop fully its defects. When these are discovered and remedied, it seems probable that its use will prove economical.

The cost of revetment during the period of high prices incident to the World War, has been about $73 per lin.ft. of bank. Prior to 1918 the cost ran about $34.

Great Flood-Protection Problems in China

By John R. Freeman
Consulting Engineer, Providence, R. I.

The regulation and guiding of certain of China's great rivers in channels better adapted for flood control and for navigation presents some of the most interesting problems of hydraulic engineering that can be found anywhere in the world. The writer had been led through personal observation to believe firmly that the control by human hands of the rivers which cause these great floods is practicable, and that it can be carried forward whenever China's domestic political affairs become straightened out and the inertia of extreme conservatism is overcome.

Floods in China imperil the lives of a greater number of human beings than anywhere else on earth. Until twenty

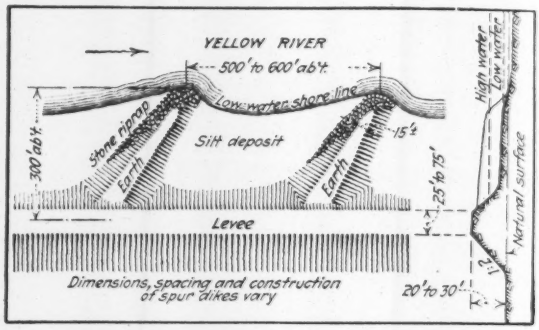


FIG. 1. HOW CHINESE HOLD YELLOW RIVER LEVEES

or thirty years ago the world knew very little about these terrible floods, because means of communication within China were so poor that knowledge of the facts filtered outward slowly and imperfectly. For example, how many know that more than a million people (some say seven millions) perished from one flood so recently as only thirty-five years ago by drowning and by starvation, in an outbreak of the Yellow River about 20 miles above Kai-feng City, which flowed southeasterly over a belt of nearly level country, perhaps 20 or 30 miles in width by 180 miles in length, down into the Huai River.

From his studies of the improvement of the Grand Canal and his studies of the Yellow River the writer has been led to have a profound confidence that great relief can be secured by an expenditure that relatively is not large, and which can be forthwith recovered in increased value of land reclaimed. The necessary structures can be largely built without the aid of steam shovels, industrial railways and the like, by native labor which badly needs employment.

It seems highly probable that the necessary works of river training and dike building, which although extensive are of a simple character, can be so built that present maintenance charges could be lessened. Also it seems highly probable that the value of waste land reclaimed could promptly be made to pay back to the government the entire cost of the river-training works and in addition bring prosperity to an impoverished region, and to other regions bring safety from impending disaster. But all of this is no short or simple task, nor can the works be designed in their best shape until after scientific tests and painstaking observation.

Important Flood Problems—From north to south there are five principal localities where flood relief needs to be studied:

(1) In the flat, level plains of the drainage basin that has its outlet past the great commercial city of Tientsin. This region suffered terribly in August and September, 1917. An area of about 15,000 sq.mi. was submerged, several million people, mostly farmers, driven from their homes, and a property loss of more than $50,000,000 gold incurred.

(2) In the delta of the Yellow River, or Hoang Ho, all along the river's 400-mile course through the delta. During the historic period of 4,200 years this region has been

ravaged by floods time and time again. These overflows come from breaks in the great dikes, and occasionally these cause a wide change in the river's course. The conditions are aggravated by the silt burden brought from the vast and easily-eroded loess deposits of the provinces just upstream from the delta, which make the Yellow River probably the muddiest great river in the world.

(3) The Huai River district in Kiang-su Province, below Wu-hu. About 5,000 sq.mi. of this peculiarly low and level delta region are said to be frequently inundated, with famine often following flood. The land is exceptionally fertile, and under a warm, growing climate normally gives two crops per year; for thousands of years intensive cultivation has been continued in spite of disasters which sometimes have brought death to thousands and at other times have merely destroyed the second of the two yearly crops.

(4) Along the Yang-tze River below Ichang. Here is the Grand Gorges the river floods are said to rise 80 ft. Below Hankow the flood discharge rises to about 3,000,000 cu.ft. per sec., which is about the same as the greatest flood discharge of the Mississippi at New Orleans. The Yang-tze River, although turbid, brings down less silt than the Yellow River, and its delta therefore grows more slowly and its whole regimen has become well established. The flood problems are mainly those of ordinary dikes and river training and control on a mighty and forbidding scale, because of the depth and volume of the water. The charts show dozens of spots where the swirl of the flood cuts pools more than a hundred feet deep, and it is no light problem to work out shore protection that will protect so deep a bank from the undercutting of such a flood.

(5) The valleys of the North, East and West Rivers in the country around and back from Canton in southwestern China. Near the important city of Wu-chow the great West River is said to rise 50 and even 80 ft. in extreme floods, and at the rate of a foot per hour.

The Chinese have had their hands full with the problems of flood control by dikes during their whole historic period of about four thousand years, and have developed a wonderfully good technique in many matters of dike building and in the repair of dike breaks, although in the science of river training they, and all the rest of us, still have much to learn.

One of the most venerated men of the half-legendary days of thousands of years ago is Yu, their great hydraulic engineer, who regulated the waters so wisely, and whose works and precepts were so faithfully followed afterward, that for over a thousand years there was no trouble, until the period of the "warring states." And the one great fact that the great restless Yellow River was held to its course during 538 years on a silted bed several feet above the level of the ground on either side, within dikes built of soft friable river silt, carefully consolidated by tamping and protected from erosion by impinging currents in many places by groins and revetments of perishable milletstalks, speaks volumes for the skill and resources of these old masters.

The flood volume of the Yellow River is from 200,000 to 300,000 cu.ft. per sec. In 1919 a flood higher than any of the preceding ten years had a peak discharge of 280,000-ft., about the same as the flood volume of the Mississippi above the confluence of the Missouri. The low-water flow is about 10,000 cu.ft. per sec. But, while the discharge from low to high thus increases 35-fold, the mean velocity becomes increased only about 2½ times. The necessary increased area of cross-section is obtained partly by the waters' rising and spreading, but largely also by the river digging its bed deeper and wider.

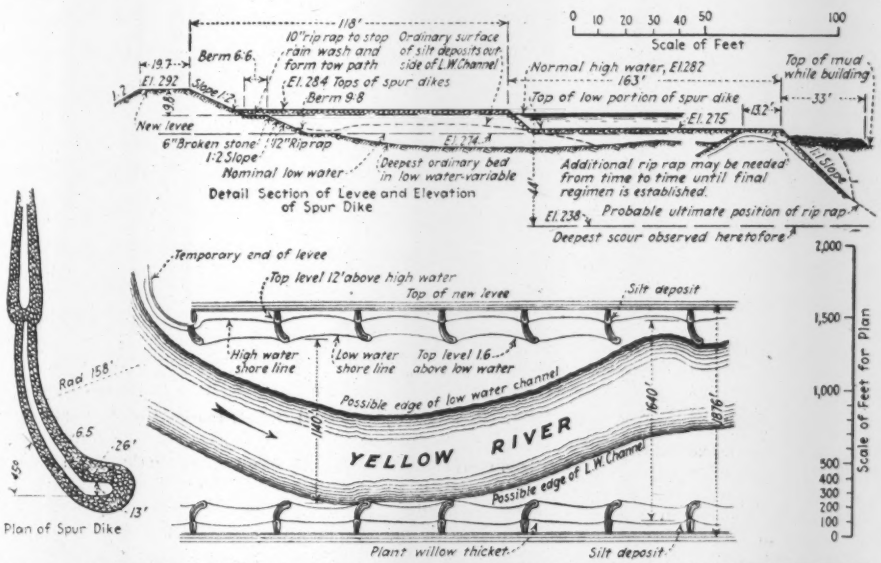

Scale of Feet
Detail Section of Levee and Elevation of Spur Dike
Plan of Spur Dike
Temporary end of levee
Top level 12' above high water
Top of new levee
Silt deposit
High water shore line
Low water shore line
Top level 16' above low water
Possible edge of low water channel
YELLOW RIVER
Possible edge of L.W. Channel
Plant willow thicket
Silt deposit
Deepest scour observed heretofore
Probable ultimate position of rip rap
Scale of Feet for Plan

FIG. 2. PROPOSED INNER LEVEE AND SPUR DIKE SYSTEM (TENTATIVE SKETCH)

A Possible Method of River Training—The chief object in the river training now proposed is protection against floods by ultimately forming a thick, flood-proof dike by means of silting up the space between the present inner dike and a new straight dike built to confine the new straight and narrow channel and hold this from meandering so that it will henceforth flow everywhere between new banks protected against undercutting by spur dikes (Fig. 2).

All things considered, the Chinese have done wonderfully well in their river training by methods they have followed for hundreds and perhaps thousands of years; but it should be possible to make great improvements by means of precise scientific observation and slow painstaking study in laboratory and field by modern instruments and methods. The river would be compelled to flow in straight courses, 5, 10 or 20 miles in length, laid out nearly midway between present inner dikes as may best fit existing conditions in different localities. The flood channel at the surface would be made only about ½-mi. in width, the centers of the main dikes being less than ½-mi. apart instead of from 4 to 8 mi. apart, as at present. The space of from 2 to 3 mi. in width thus left between the old inner dike and the new straight dike would ultimately become silted up to nearly the level of ordinary floods, forming the most fertile kind of agricultural land, but presenting the great superiority of having the admission of flood water always controlled until growing crops had been harvested by substantial sluiceways and gates built into the new dikes. After the crop had been harvested the admission of more or less flood water occasionally would add to the fertility, and the maintenance of a deep-seated reserve of moisture in the sub-soil would be aided by saturating this bottom land by these occasional overflows. When this broad terrace of earth between old dike and new dike had become built up to about the level of ordinary floods, it is obvious that if the inner dike became overtopped or undercut by the current under extraordinary conditions, that this barrier of elevated ground about 2 miles in width in front of the old dike would prevent any rapid outrush of water from causing disasters like those of 1887 and 1851 or the countless series of outbreaks that have occurred from time immemorial, all along the course of the river through the delta.

Cleaning Up the Building Labor Situation in Chicago

(An editorial impression)

FOR years Chicago has been noted for serious disturbances in the building industry. There have been a number of protracted strikes shutting down work completely. But Chicago is working out its salvation. A strong organization, known as the Citizens' Committee to Enforce the Landis Award, has been formed and apparently is mastering the situation. The end is not yet, but good results have already been secured and the outlook is promising.

The organization of the committee was the culmination of events following a seven-weeks' strike in the building trades beginning May 1, 1921, which grew out of a demand by the contractors for a reduction in wage from $1.25 to $1 per hour. Finally the opposing parties agreed to submit the matter to arbitration and, at the suggestion of the unions, Judge Kenesaw M. Landis was selected as sole arbitrator.

On Sept. 7, 1921, the arbitrator rendered a decision which set lower rates in practically all of the trades and laid down rules abolishing the restrictions of output practiced by the unions. (For data on this decision see *Engineering News-Record*, Sept. 15, 1921, page 467.)

The contractors accepted the award, but some of the unions lodged protests against it and ultimately decided not to abide by its provisions. The situation, for a time hopeful, again gave promise of becoming chaotic. At this juncture a group of citizens took the matter in hand, realizing that if the Landis award were made a scrap of paper Chicago was doomed for an indefinite time to be at the mercy of the pirates who dominated some of the strong unions. They, therefore, solicited the support of other loyal Chicagoans with the result that there was formed the Citizens' Committee, pledged to a fight to the finish to secure the adoption of the award by the whole building industry of Chicago. It was realized that this was no simple matter, nor one that would be finished in a few months. In fact, it was apparent that if Chicago was to continue to enjoy good working conditions in the building industry, the organization must be permanent. Accordingly the committee announced that it needed contributions totaling $3,000,000, to provide funds not merely for the initial fight but for the permanent establishment, incorporation and conduct of the organization. By the end of March $1,800,000 had been paid into the treasury, with the remaining money pledged, an evidence of the public approval of the committee's object.

Hearty approval has come, too, from other directions. The architects of the city with few exceptions have agreed to give work only to contractors who will work under the award, while many of the bankers will advance building funds only on projects being carried out under Landis award agreements.

The make-up of the committee is a guarantee that the fight will be vigorous and that there will be no compromise. Included in its membership are such prominent Chicagoans as Thomas E. Donnelley, of the Reuben H. Donnelley Corp., printers, chairman; John W. O'Leary, of the Chicago Trust Co., vice-chairman; James A. Patten, the well-known grain merchant; Charles Piez, president of the Link-Belt Co., and John T. Pirie, of the wholesale drygoods firm of Carson, Pirie, Scott & Co.

Platform and Procedure.—As its platform the committee adopted the following declaration:

"1. Employers who continue their operations under the terms of the Landis award will be encouraged and when necessary, protected in their operations.

"2. Unions which accept the terms of the Landis award, both in spirit and fact, will be supported.

"3. The sale and use of material going into building operations must be free from arbitrary restrictions.

"4. Contractors who refuse to operate under the Landis award deserve neither the encouragement nor the support of the public.

"5. In those trades where the unions do not accept the terms of the Landis award, work shall continue by workmen who are willing to work, regardless of their union affiliations. These men will be protected and these trades will be permanently established on the basis of the open shop."

The committee's method of procedure was to open negotiations both with the contractors and with the unions. Contractors were asked to agree to hire only men who would work under the Landis award. The unions were asked to accept the following three planks:

1. To abide by the Landis award and to give up all restrictions as to output or use of materials.
2. To agree not to engage in sympathetic strikes.
3. To work on jobs with non-union men.

On the whole there was greater difficulty with the contractors than with the unions, for many contractors wanted to retain freedom to recruit their forces at inflated wages should the supply of building mechanics be limited. In some trades weeks were required before it was possible to get the first group of contractors to sign up with the committee. To date, however, a goodly group of contractors in every trade has been signed up, so that it is possible to proceed with every kind of building work.

Negotiations with Unions.—In negotiating with the unions the committee took the position that if they agreed to abide by the Landis award, the committee would recognize them as the accepted labor group in their particular trades, thus making those trades "closed shops." If, on the other hand, the unions refused to accept the award, the committee announced its purpose to declare those trades "open shops" and thereafter to have no dealings with those unions, though members of the unions as individuals might be employed on building operations, provided they as individulas agreed to abide by the terms of the award. The committee made it clear that once a union was outlawed and that trade declared an open shop, it would remain so permanently and that under no circumstances would the committee compromise and have any relations with the union in question. Up to the present time twenty-one unions are operating under the award, while ten have been outlawed because they refused to accept the award and those trades are now operating on the open-shop basis. Negotiations with the remaining one of the thirty-two trades are still in progress, their contract with the employers having run until April 1.

Naturally, when a given trade was declared an open shop, difficulty was experienced by the contractors in finding adequate help. The Citizens' Committee therefore began to recruit men at other points, with the result that there are now ample supplies of labor in every one of the outlawed trades. In Chicago itself the

committee is conducting an employment office where all men working in the open-shop trades are obliged to sign up, agreeing to abide by the Landis decision, before they are placed.

Relations between the contractors and the unions which have signed up are those normally existing between these groups, the employers calling upon the unions for forces and settling disputes with them without the intervention of the Citizens' Committee.

To date large economies have been experienced as a result of the abrogation of restrictions. Bids on identical work show large reductions this spring over those of last fall, while contractors report greater efficiency on the part of the workers. A building alteration job, for example, on which the bid was $103,000 last October was actually let in March at $68,000. The owner stated, also, that this was the first time in five years that he had been able to do work without paying any graft.

Naturally, the cost of the work done by the committee—such as the maintenance of the necessary organization for carrying on negotiations, the hiring of scouts, the establishment of an employment office, the provision of guards for protecting buildings where violence is feared, and the carrying of insurance to reimburse contractors and owners against damage due to possible violence—is large. Up to the end of March the committee had spent $350,000, and at that time was carrying insurance against vandalism totaling $32,000,000.

Not the least of the work of the committee has been to get its message before the citizens of Chicago. Naturally, the situation has attracted widespread attention and has secured much newspaper publicity. In addition, however, the committee has put forth various documents for distribution to the public, while members of the committee have for months been doing one-night stands at the meetings of civic bodies in every part of the city.

The Outlook.—Even so, it is fully recognized that the fight is not yet won. However, the fact that work can now go forward in every branch of the building industry, that more contractors are signing up every day, and that the beneficial results in lowered costs are beginning to appear indicates that the committee will be able to carry its work to a successful conclusion. One of the difficulties is that not all of the contractors have yet signed up to work under the award. These men form a group of bolsheviks who may have a serious influence on the situation, by overbidding the Landis wages and tolerating the restrictions should there be a pressing shortage of building mechanics. Every effort is being made to bring these recalcitrant contractors into line and to put the whole building industry of Chicago under the Landis award.

French Railways in 1921

The gross operating receipts of the French railways for the calendar year 1921 exceeded those of 1920 by over 400 million francs, yet there was a larger deficit for 1921 by over 120 million francs than for the year previous. Advances of from 70 to 80 per cent in passenger fares and of 140 per cent in freight rates accounted for the increased gross revenues but these were offset by operating expenses exceeding those of the previous year by over 560 million francs, the figures for expenses being estimated.—*Commerce Reports.*

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Defense of Professor Melan

Sir—In justice to Professor J. Melan, who has done invaluable pioneer work in developing the theory and construction of various bridge types, I want to correct certain erroneous impressions which may be gathered from your editorial on "Self Supported Arch Reinforcement" in your issue of March 30, p. 513.

In that editorial you make comparison between a type of construction employing small shapes for reinforcement, which you refer to as the Melan type, and another system employing rigid, self-supporting steel reinforcement. The fact of the matter is that the second type, which you praise to the disparagement of the first, is really Melan's system of arch construction as developed and perfected by him.

All authorities agree that the characteristic feature of the Melan system is the rigid, self-supporting reinforcement. In the earliest Melan arches built in this country, about 25 years ago, the reinforcing ribs were built up of smaller structural shapes corresponding to the small dimensions of the spans, but the principal was there.

In my translation of Melan's "Plain and Reinforced Concrete Arches" (Wiley, 1917) I have emphasized this feature of rigid, self-supporting reinforcement throughout. Facing pages 115 and 119 I have inserted photographs of a Melan Arch during construction, to show how the reinforcement remained self-supporting after the centering was carried away by a flood. All of the Melan arches pictured have rigid, self-supporting reinforcement of structural steel.

The use of the rigid reinforcing ribs to support dead-load during erection is also part of Melan's system as developed by him. The American owners of the Melan patents did not take advantage of this principle, but Melan applied it in the design and construction of his arches in Europe. Permit me to quote from my translation of his book which he wrote over 10 years ago. In the chapter on "Proportioning Reinforced-Concrete Arches," page 114, you will find the heading: *"Rigid Reinforcement Carrying Part of the Dead-Load (The Melan System),"* and the text—"If the arch-curve conforms to the correct line of pressure and the live-load is not too great, only small tensile stresses will appear. Furthermore, since the maximum intensity of compression in the steel cannot exceed $n = 15$ times the value for concrete, or about 6,000 to 7,500 lb. per square inch, it is evident that *the full strength of the steel cannot be utilized in the ordinary arches of reinforced concrete.* This waste of strength may be avoided, however, by using self-supporting reinforcement (as in the Melan system) and hanging the forms on these steel reinforcing ribs; a portion of the dead weight of the structure is thus transferred directly to the steel, so that the latter receives a certain initial stress before the concrete is stressed at all."

In the succeeding pages, Melan develops the theory of his system and illustrates it by examples from his designs.

All of the advantageous features which you commend in your editorial are fully covered in Melan's work. He employed the principle of suspending the forms from the rigid reinforcement as far back as 1898.

I hope you will feel, as I do, that credit should be given where credit is due.

D. B. STEINMAN,
Consulting Engineer.

New York, April 18.

[It is obvious from Mr. Steinman's evidence that the Melan principle included self-supported reinforcement, which in turn could carry the concrete during construction. The editorial doubtless emphasized too much the type of construction actually carried out in the United States under the Melan patents, in which dead-load was not carried by the reinforcement.—EDITOR.]

NEWS OF THE WEEK

New York, April 27, 1922

Contractors and Dealers Are Heard in Cement Trial

Uniformity of Price Testified to But Competition Also Indicated in Activity of Salesmen

In the examination of more than a score of contractors and dealers in building materials, operating in various parts of New York, Pennsylvania, and New Jersey, evidence has been adduced during the past week in the criminal trial of cement manufacturers of the Eastern district before Federal Judge Knox in New York that a striking uniformity of price has existed in cement quotations, discount practices, bag charges and bag refund allowances. These details have been dwelt upon in the examination of each of the witnesses called by the government. However, the defense has met such evidence by further bringing out the fact that the uniformity existed long before the formation of the Cement Manufacturers Protective Association in 1916, and by showing on cross-examination that (1) manufacturers have often used dealers in the endeavor to discover quotations from competing firms, (2) that in the establishment of a new uniform price there is usually a two- or three-day lag between the new price as quoted by the firm undercutting or raising and the quotations from other manufacturers to meet the new price and (3) that cement salesmen are most active in calling upon dealers in the endeavor to get business.

Other Witnesses

Other witnesses examined included William M. Kinney, general manager of the Portland Cement Association, and Miss Mary F. Kavanagh, formerly in the employ of the Atlas Portland Cement Co.

The examination of Mr. Kinney had to do with the formation of that association and endeavors to promote the use of cement in structural and highway work. The government in Mr. Kinney's examination introduced further documentary evidence composed largely of correspondence passing between Mr. Kinney and members of the association.

When Miss Kavanagh was called to the stand she was examined largely as to her association with and knowledge of the formation of the Cement Manufacturers' Protective Association, in which the Atlas Company had a leading part. She proved a willing witness for the government, but repeated objection was made by counsel for the defense as to the inclusion in her testimony of irrelevant material which was ordered stricken out by the court. In cross-examination she proved an unwilling witness and had to be admonished often by the court for failing to answer properly and for arguing with counsel. One point in her examination sought by the government was to establish the fact she had been instructed to withdraw "damaging" correspondence from the Atlas files by Mr. Holman, then assistant to the president. Miss Kavanagh testified to the fact verbal instructions were so given. Later evidence proved the fact Mr. Holman was away from the company's offices during the time specified.

During the closing session of one day last week considerable discussion was engaged in over the admissibility of certain evidence.

Mississippi Levees Still Hold Flood

Col. Charles L. Potter, Corps of Engineers, U. S. A., and President of the Mississippi River Commission wired "Engineering News-Record," April 25 that the flood on the Mississippi was being held between the levees. The telegram says:

"Unprecedented flood heights obtain in a portion of the lower Mississippi. Floods at Cairo usually come from a very high Ohio and a moderately high upper Mississippi and upper Mississippi floods generally occur in June after the Ohio has fallen. In April this year heavy rains in the upper valleys caused an excessive flood in the upper Mississippi and a moderate flood in the Ohio occurred in March. Cairo gage recorded about 1 ft. below its record at the crest of the Ohio flood, then fell about 3 ft. and has risen about 3 ft. while the upper Mississippi gages are below record heights down to the Arkansas and White Rivers, which tributaries were in flood at the critical time. The natural spillway at Cypress Creek just below the Arkansas River whereby some 200,000 sec.-ft. formerly left the main river in high floods and returned via Bayou Macon, Black River and Red River has been closed since the last great flood. This with the flooded White and Arkansas has already produced heights beyond all records at Arkansas City, Greenville and Vicksburg and will probably carry on to Red River, there being no return water from the Red and with the Red and Ouachita Rivers falling, the Atchafalaya outlet will be able to furnish great relief. No record heights are expected below Red River. No levee under government control has broken except a small one near the mouth of the river. One private levee not in the main line has broken, flooding a small area. We are putting up a hard fight from the Arkansas to the Red. Congress has provided a million dollars. The levee boards are co-operating magnificently and we are going to win."

Flood at Fort Worth, Texas

Excessive rainfall on the Trinity River above Fort Worth, Texas, (reputed as 9 in. in 12 hours) on April 25 caused a rapid and serious rise in the river with consequent flooding of part of the city. Full reports are not available as this issue goes to press.

Postpone Hearings on Plans for Railroad Consolidation

Hearings on the plan for consolidation of all major railroads of the United States into nineteen great systems were begun April 24 by the Interstate Commerce Commission. As the railroads generally were not ready to proceed it was agreed to adjourn the hearings indefinitely.

First consideration is to be given to the roads in the southeastern section of the country which are to formulate a program for the study of the problem and submit it to the commission for its approval. Objections to the plan proposed for this section have been raised by the Southern States.

Philadelphia Receives Bids on Girard Municipal Piers

Bids for the construction of the superstructure of Pier 3, North, and of the substructure and superstructure of Pier 5, North, of the Girard group of Municipal piers in Philadelphia have been received by the Department of Wharves, Docks and Ferries. This is reported to be the largest single contract yet offered by the city in connection with its Delaware River waterfront development plan.

Five bids were submitted, ranging from that of the Triest Contracting Co. at $1,812,218 up to $2,045,000, based on plain-concrete floors; and from $1,845,548 by the same low bidder up to $2,080,000 based on asphalt-block floors.

It is planned to have the Girard group of piers in service in 1923.

Hampton Roads Port Commission Appointed by Governor

Governor E. Lee Trinkle, of Virginia, has announced the appointment of the following as members of the Hampton Roads Port Commission, created by the last general assembly to aid in the development of ports and rivers in and around Hampton Roads, Va.: N. D. Maher of Roanoke, Va., president Norfolk & Western R.R.; Henry G. Barbee of Norfolk, Va., president Norfolk Chamber of Commerce; Homer L. Ferguson of Newport News, Va., president Newport News Shipbuilding & Drydock Co.; W. M. Martin of Petersburg, Va., secretary Petersburg Chamber of Commerce; W. E. Carson of Riverton, Va., manufacturer, and John R. Saunders, attorney general of Virginia, ex officio.

Power License Granted To Cover San Joaquin River Project

A license under the Federal Power Act has been granted to the Southern California Edison Co. covering its $13,000,000 project on the San Joaquin River in Fresno and Madera Counties, Cal. The primary power available is 112,000 hp.

The project works include a concrete arch dam 100 ft. high; a tunnel 21 ft. by 21 ft. and 28,000 ft. long. The power house will contain six turbines which will operate with a mean static head of 825 ft. They will be capable of developing 195,000 hp. There will be two parallel 220,000-volt transmission lines, one and one-half miles long, which will connect the power house with the double transmission line to Los Angeles.

Bonds for Activated-Sludge Plant Voted by Pasadena, Cal.

By a majority of 5 to 1 the voters of Pasadena, Cal., on April 11 approved a bond issue of $325,000 for an activated-sludge plant and for increasing the capacity of its outfall sewer. The effluent from the plant will be used on the sewage farm that has been owned and operated by the city for many years. It is expected that South Pasadena and Alhambra, which joined with Pasadena several years ago in investigations for a joint sewage-works, will have sewage-bond elections soon. In 1915, Pasadena voters negatived an ocean-outlet sewer project. The results of the recent Pasadena election were awaited with interest in Los Angeles in view of the controversy in the larger city over a new ocean outfall as against activated-sludge plants.

British Railways Resume Speed

(London Correspondence)

Following many complaints, voiced largely through the *Times*, London, as to slow train-speeds in Britain since the war, there has been a general speeding-up, together with a closer adherence to schedules. The South Eastern & Chatham, for example, notwithstanding that it must operate through a very congested section of the environs of London, showed during February an average lateness of trains at the London termini as follows: Cannon St., 0.95 min.; Charing Cross, 0.68 min.; Victoria, 0.78 min.; Holborn, 0.53 min.; Ludgate Hill, 0.10 min.; St. Paul's, 0.20 min. These stations handle both local and main-line traffic and the figures include delays from every cause.

The Great Western Ry. also has speeded up. The average speed on the London-Birmingham run, about 110 miles is, 57 m.p.h. The Bristol-London run of 118 miles is made in 2 hours. The log of one trip of this train follows:

Station	Schedule Time	Actual Time	M.P.H.
Bristol	12:00	12:00	....
Badminton	12:25	12:32	33.05
Swindon	12:47	12:52	68.14
Milton	1:05½	1:09½	73.67
Reading	1:23½	1:27½	66.13
Slough	1:40	1:42	72.52
Paddington (London)	2:00	2:00	61.50

The Penzance (West of England) train, which leaves Exeter at 1:45 ran to Paddington (173 mi. 53 ch.) in 174 min., the average speed being 59.88 m.p.h. The highest speed on this run was 67.16 m.p.h.

Federation Reports Increased Engineering Employment

Distinct improvement in the unemployment situation in the engineering profession is reported by the Federated American Engineering Societies' Employment Bureau, 29 West 39th Street, New York. During the first quarter of this year 778 available positions were sent to the bureau as against 347 for the same period in 1921, an increase of 124 per cent. The number of men placed showed an increase of 41 per cent, rising from 293 during the first three months of last year to 415 during the quarter just passed. The number of new men registering with the bureau fell from 552 last year to 421 during the first three months of this year, a reduction of 24 per cent in applicants for positions.

Many of the positions available are in what is classed as the junior grades, draftsmen, estimators and similar jobs, but there is an increased number noted in the higher-grade openings which are sent in, indicating that many companies are actively preparing for a return to more normal conditions. The gradually-increasing activity does not appear to be confined to any particular line, but is more or less general.

Transportation Policies Outlined by Agricultural Inquiry

"Transportation requires constructive and helpful governmental and public treatment rather than repressive or restrictive regulation," recently declared Chairman Sydney Anderson of Minnesota, speaking for the Congressional Joint Committee on Agricultural Inquiry. "We are convinced," he continued, "that whatever else may be or can be done by Congress or the government to help all business, including agriculture, to readjust and stabilize itself, transportation is a vital factor and must be dealt with equitably and constructively if the country is to go forward and prosper."

As the fruits of an investigation which has been in progress since August, 1921, the forthcoming report of the commission is expected to present many definite and far-reaching recommendations bearing on the relation of transportation to agriculture and industry. The recommendations directed to Congress, Mr. Anderson states, will be confined to matters wherein Congress has power to legislate and wherein there is need for legislative action.

Electrical Engineers Nominate 1922 Officers

The board of directors of the American Institute of Electrical Engineers at its meeting in New York, March 17 selected by ballot the following list of "Directors' Nominees" for offices falling vacant July 31, 1922: For president, Frank B. Jewett, New York City; for vice-presidents; District 1, G. Faccioli, Pittsfield, Mass.; District 3, W. I. Slichter, New York City; District 5, R. F. Schuchardt, Chicago, Ill.; District 7, H. W. Eales, St. Louis, Mo.; District 9, H. T. Plumb, Salt Lake City, Utah; for managers, H. M. Hobart, Schenectady, N. Y., Ernest Lunn, Chicago, Ill., G. L. Knight, Brooklyn, N. Y.; for treasurer, George A. Hamilton, Elizabeth, N. J.

California To Vote on State Hydro-electric Ownership

Initiative Measure to be Acted Upon In November Proposes Board With Broad Powers

As an initiative measure there will come before the people of the state of California in the election November, 1922, a constitutional amendment known as the California Water and Power Act, which if approved by the majority of the state, will immediately become a law without the necessity of further legislation. The amendment creates a board which has large powers in the control of water and the distribution of power, and in effect establishes in California state ownership of power similar to that in vogue in Ontario under the Hydro-electric Power Commission.

Powers of the Board

The California Water and Power Board under the act will be composed of five members appointed by the governor, but removable by the legislature by a two-thirds vote of all its members on charges of "dereliction of duty or corruption or incompetency." Provisions are made for the future passage of a law for the removal of members also by recall. This board has almost unlimited power "to do any and all things necessary or convenient for the conservation, development, storage and distribution of water for the generation, transmission and distribution of electric energy" and "to purchase, acquire, produce, manufacture or otherwise provide facilities, materials and supplies raw or finished and any property or thing necessary or convenient for the accomplishment of the purposes of the law, to co-operate and contract with the political subdivisions of the state concerning the use of water and generation of electricity, and to supply or construct for said subdivisions distribution systems."

The board is supreme except for a committee composed of the governor, comptroller, treasurer, chairman of the Board of Control and chairman of the Water and Power Board, which issues and sells bonds but has no discretion as to whether or not bonds shall be issued. Bonds of the state not exceeding the sum of $500,000,000 may be issued and sold by the commission and the full faith and credit of the state is pledged for the payment of the principal of the bonds and the interest thereon.

The board is to establish the rates for service without review by any other state body. The body is finally given the right of proceeding in eminent domain. The determination of the board that the taking of the properties described is necessary is to be conclusive evidence of such nessity.

Sawmill and Village To Be Built by Same Contractor

Contract for the construction of an electrically-operated sawmill at Denco, Miss., has been awarded Dwight P. Robinson & Co., New York City, by the Denkmann Lumber Co. The contract includes building a village of about 50 houses, churches, schools, etc. Additional work at other Mississippi towns is to be done by the same company.

Indicted for Phillipsburg Sewage-Works Extras

Conspiracy Charged Against Engineer and Contractors—Town Commission Declared Inefficient

Indictments for conspiracy to defraud the town of Phillipsburg, N. J., in securing $23,000 for extras on the contract for the Landreth direct-oxidation sewage-works have been returned by the Grand Jury of Warren County against the Municipal Disposal Co. of Philadelphia, H. Jerome Hirst, president, Charles E. Parry, engineer of the company, Korp & Korp, sub-contractors, for parts of the work outside those essential of the Landreth process, and C. E. Tilton, formerly town engineer of Phillipsburg. Mr. Tilton is also indicted for malfeasance in office. Four of the five town commisioners (the fifth having been elected after the contract was completed) are severely censured by the Grand Jury for disregard of state laws in letting contracts and in authorizing contract payments, expending money in excess of appropriations, ignorance of the laws of the state governing municipalities, and lack of business methods, but much of this censure is not based on the sewage-works contract. The Grand Jury reported that it did not find evidence that would warrant the indictment of the commissioners. It placed on the voters the responsibility for electing "incompetent and inefficient public officials."

The indictments and censure are the sequence of an investigation of the conduct of Phillipsburg town affairs, conducted by a former state judge, Frederick W. Gnichtel, of Trenton, acting as commissioner of the State Supreme Court in response to a taxpayers' petition alleging irregularities and mismanagement in the conduct of town affairs. Charles B. Brady, of Phillipsburg, was counsel for the taxpayers.

Results of Investigation

Judge Gnichtel's report, filed in November, 1921, although going into various phases of town mismanagement, dealt largely with the municipal disposal contract. He found that the town commission never rescinded its adoption in 1918 of plans for sewage treatment by Riensch-Wurl screens and chlorination, submitted early in 1917 by the late Robert P. Howell, then town engineer, and George W. Fuller, consulting engineer; that in Feburary, 1919, the commission signed a report by C. E. Tilton, then town engineer, advising that the Landreth direct-oxidation system be substituted for screens and chlorination, but that neither then or subsequently did the commission formally adopt the Landreth process by ordinance or resolution. The commissioner found that late in 1919, the commission awarded a contract to the Municipal Disposal Co. for a direct-oxidation plant for $138,000—$122,000 for its own machinery in place and $25,980 for all other material and work, and that the company sublet all the work, except for its machinery, to Korp & Korp, for cost plus 15 per cent. The commissioner also found that although by statute a bond equal to the contract price should have been put up, one for only $32,000 was accepted, and that at the time of the investigation no one could tell where that bond was.

The conspiracy charges of fraud on $23,000 extras are based on the subcontract. The commissioner reported that although the Municipal Disposal Co. agreed to do the work outside of its machinery for $25,980. It was allowed extras totaling $26,556, "without any official action on the part of the commissioners." The bills for these extras were made out and sworn to by Mr. Tilton, the commissioner states, some of them, at least, on the mere say so of the sub-contractors. The irregularities cited by the commissioner include a statement to the effect that although Korp & Korp took the subcontract on a 15-per-cent-plus basis, they added a profit on cement before figuring the 15 per cent. The commissioner states that the books of Korp & Korp for the year the work was done were burned early in 1921, but that Korp & Korp claimed this was their usual practice.

Mr. Tilton resigned as town engineer of Phillipsburg shortly after the court commissioner's report was filed.

Bill Provides for Colorado River Control

A bill introduced on April 26 in the Senate by Senator Johnson and in the House by Representative Swing, both of California, authorizes the construction by the federal government of a dam at Boulder Canyon on the Colorado River and the construction of a canal from the river at Laguna Dam to the Imperial Valley. Provision is made to issue permits for water-power generation and distribution, first to political subdivisions and then to private companies under proper federal control. The dam and reservoir are to be used, "first, for river regulation and flood control; second, for irrigation, and third, power." A sum of $70,000,000 is appropriated for the dam.

El Paso and Jaurez Plan Flood and Mosquito Protection

Both the flood menace from the Rio Grande at El Paso and the mosquito-control problem are being investigated by committees of the El Paso Chapter of the American Association of Engineers. In addition, there is an international committee representing El Paso, Tex., and Juarez, Mexico, that has been appointed to recommend a plan for ridding the two cities of the mosquito nuisance. On the internationa committee are J. L. Campbell, chief engineer, El Paso & Southwestern Ry., who is serving as chairman, W. C. Stewart, city engineer of El Paso, E. A. Paredes, city engineer of Juarez, and A. B. Colin, of the International Boundary Commission. The A. A. E. committee on the mosquito nuisance has already recommended the construction of levees along the Rio Grande and the drainage of low lands.

As to Rio Grande floods, since the construction of the Elephant Butte dam above El Paso the river-bed at El Paso has risen 6 to 7 ft. Mosquitoes at El Paso first became a problem in 1921 and that Dr. J. W. Tappan, of the United States Public Health Service, is of the opinion that unless immediate preventive measures are taken the mosquito menace will be much greater this year than last.

Engineering Employment Shows Decided Improvement

Signs of increased employment of engineers continue, according to the employment department of the American Association of Engineers. More positions were received, more men placed and a greatly-reduced number of men were available at the end of March than for the past five months. The number of engineers actually unemployed is small—only a few in the construction field and a smaller number in the industrial field. The unemployed in other fields is negligible.

The demand for architects, architectural engineers, draftsmen, structural draftsmen and designers with building experience far exceeds the supply in the Central West. Salaries for men of this class of work have increased materially. Tracers receive in many cases as high as $40 a week at the start, while good draftsmen command as high as $350 a month. A few positions are open for construction engineers and superintendents but not enough to equal the supply. The following table shows the trend of employment:

	March 1922	Feb. 1922	March 1921
Applicants for employment	1,696	1,968	2,329
Positions received	407	312	652
Men referred	1,868	1,475	3,532
Men placed	216	172	276

The average monthly salary of positions filled during March was $196, or $10 more than the previous month; for the same month last year the average salary was $203. The highest salaried position filled was $7,000; seventeen positions were filled at salaries of $5,000 and over. The lowest salaried position was $100 a month. The greatest demand for engineers at this time exists in the Central West and the East which is showing an improvement in the industrial situation. A healthy demand exists in the West for engineers of certain classes.

Students and undergraduates this season will have little trouble in obtaining employment. The highway and municipal fields will require the services of many of this younger class, and students in mechanical, electrical and chemical engineering will find employment with industrial companies who are now making places in their organizations as a result of improved conditions.

The most important factor in engineering employment is the apparent attainment of a much greater degree of economic adjustment and stability than previously recorded. The situation, as seen by A. A. E. officials, is far more promising than any that has prevailed for some time.

San Antonio Plans Auditorium

Plans are being drawn for a municipal auditorium by San Antonio, Tex., to be erected in Madison Square. These plans will call for a steel and concrete structure with a seating capacity of about 6,000; the sum of $500,000 is available for the purpose. The planning is being done by Ralph H. Cameron, architect, under the general supervision of the city engineer, D. D. Harrigan, who will also have charge of construction. It is anticipated that the work will start about July.

Philadelphia Bridge Caisson Is Launched

The west or Philadelphia pier caisson for the Delaware River suspension bridge was launched successfully on April 24 at the yard of the New York Shipbuilding Co., Camden. The structure was christened in accordance with regular shipbuilding practice, being given the name "Keystone State."

As launched, the caisson, whose ground-plan dimensions are 70 x 143 ft., was 52 ft. high above cutting edge, or something more than 40 ft. above the roof of the working chamber. It had all reinforcing and all air locks installed, and part of the shafting. A false bottom was placed under it for launching, to check the impact of the water on the transverse partitions in the working chamber. This bottom floated away as soon as the caisson was fully in the water, and the structure settled to 11½ ft. draft. It will be pulled over to the wet dock, the remaining installation made, and 14 ft. of additional cofferdam built on top of it. With this work completed, early next week, it will be towed over to the pier site ready for sinking. It is to be sunk by filling with concrete, which operation will consume probably several days before the structure rests on the river bottom. The bridge commission last week approved contract forms for the first section of the anchorages. This section includes the concrete core and all the anchorage steel for the structures on both sides of the river. Bids are to be asked shortly.

New England Health Institute Will Hear 76 Addresses

Seventy-six addresses by as many speakers will be delivered before the New England Public Health Institute, at Hartford, Conn., May 1-6. There will be twelve separate courses, including those on health administration, preventable diseases, sanitation, and industrial hygiene. The Institute is under the auspices of the United States Public Health Service, the health boards and departments of the six New England states, and the medical schools at Harvard and Yale. The topics of most likely interest to engineers with the corresponding speakers and the days on which the addresses will be made are:

Tuesday, May 2—Protection of Water Supplies, Sol Pincus, sanitary engineer, U. S. Public Health Service; Pollution of Streams, James A. Newlands, Connecticut Public Health Council; Chlorination of Public Water Supplies, Caleb M. Saville, engineer and manager, Hartford water-works. *Wednesday* — The Health Department and the Community. Prof. C.-E. A. Winslow, Yale Medical School. *Thursday*—Rural Health Work, Dr. L. L. Lunsden, U. S. Public Health Service; Sanitation of Public Bathing Places, S. DeM. Gage, chemist and sanitary engineer, Rhode Island State Board of Health. *Friday*—The United States Public Health Service, Dr. H. A. McLaughlin, assistant surgeon-general; Garbage Treatment and Disposal, M. N. Baker, associate editor, *Engineering News-Record;* International Health Problems, Prof. Winslow.

A reception and dinner will be given to the faculty, as the 76 speakers are called, on Thursday evening, May 4, at which Dr. McLaughlin and others will speak.

Indiana Flood-Prevention Work To Be Active

A large amount of flood-prevention work is likely to go on in Indiana during the coming two years, according to local reports. Work in many counties has been held up since the 1913 floods because of mounting prices. Now it is to be pushed ahead of much other public construction. In the floods of the past two weeks almost every city in the state on a stream subject to flood has been damaged, except Indianapolis, where millions of dollars were spent five years ago in flood-prevention work and retaining walls.

Illinois Central Plans to Spend $50,000,000 in Chicago

Issuance of $50,000 preferred stock by the Illinois Central R. R. to be used for electrification and other major improvement of the company's property in Chicago was approved at the stockholders' annual meeting on April 19. President Charles H. Markham expects that work will begin within a year.

Rival Tickets for Directorate of Road Builders' Association

Rival tickets for the incoming directorate of the American Road Builders' Association, to be chosen by letter ballot closing May 12, are supported in letters which have been mailed to the membership under dates of April 18 and 21. Special importance attaches to the choice of directors this year inasmuch as they are empowered, under the revised constitution, to elect the new president, treasurer, and secretary of the association.

Col. H. L. Bowlby, over his signature as president of the association and on its official stationery, has sent out a communication in the interests of the following candidates: H. K. Bishop, U. S. Bureau of Public Roads; C. P. Fortney, State Road Commission of West Virginia; W. R. Neel, state highway engineer of Georgia; George C. Diehl, engineer, Erie County, N. Y.; Francis P. Smith, consulting chemist and paving engineer, New York; M. F. Bramley, president, Cleveland Trinidad Paving Co.; Frank Terrace, Washington State Good Roads Association.

Opposed to the foregoing ticket is one which has the support of the Highway Contractors' Association of New Jersey in a communication signed by Albert V. Barrett, its executive secretary. This letter urges the election of T. J. Wasser, state highway engineer of New Jersey, as president of the association; James MacDonald as treasurer, and Charles M. Upham, state highway engineer of North Carolina, as secretary. Recipients of the letter are urged to vote for the following directors: Col. R. Keith Compton, chairman, Paving Commission, Baltimore, Md.; E. J. Mehren, editor, *Engineering News-Record*, New York; H. K. Bishop, U. S. Bureau of Public Roads, Washington; W. Tom Winn, Georgia State Automobile Association; Joseph F. Helm, Standard Oil Co. of Louisiana; R. J. Windrow, consulting highway engineer, Jefferson City, Mo.; R. H. Stalnaker, assistant state highway engineer, Sacramento, Cal.

Sacramento Filtration-Job Controversy Ends

Board of Three Awards Contractor $25,000 With Equal Division of Arbitration Cost

Decision was rendered on March 27 by an arbitration board of three engineers selected to review the controversy between the city of Sacramento and the Coast Construction Co. over the construction of the new Sacramento water-supply system contract for the construction of which was canceled by the city. The points at issue were (1) the right of the city to suspend the work on Jan. 2; (2) to cancel the contract; (3) the amount of fee due in settlement. The main features of the contract were published in *Engineering News-Record*, Jan. 13, 1921, p. 77.

The contract was for the construction of a portion of the new filtration project to supply the city with water from the Sacramento River and was dated Dec. 31, 1920. The fee for supervision was to be $82,109 and the estimated actual cost, including overhead, was $807,294. The penalty provided was 50 per cent of over-run above this estimate, not exceeding $41,055. The bonus provision applicable with under-runs below the estimate was similar.

Pay Withheld and Work Stopped

On Oct. 31, 1921, the city engineer withheld the payment of a fee on the ground that the cost of the work was exceeding the estimate on which penalty was based. On Jan. 2, 1922, the resident engineer suspended work under the contract. The contractor then asked for arbitration, as provided in the contract. The contract was cancelled by the City Council on Jan. 26 during the arbitration proceedings and the contractor also submitted this action to arbitration.

At the hearing before the arbitration board the contractor presented claims amounting to $127,703. The city claimed the sum of $23,579 as due in settlement of the $41,055 penalty provided in the contract, claiming that the estimate of contract work had been over-run about $211,000.

The arbitration board awarded, in full settlement of all claims, the payment of $25,000 by the city to the contractor with an equal division of the cost of the arbitration, and held that the city had the right to suspend the work and cancel the contract.

The members of the board were J. R. Lippincott, consulting engineer, Los Angeles, for the city of Sacramento; A. J. Cleary, consulting engineer, San Francisco, for the contractor; and G. A. Elliott, chief engineer, Spring Valley Water Co., selected by the two first named.

East Jersey Water Co. Ruled Out on Rate Application

The East Jersey Water Co. has been ruled out of the application filed by itself and associated companies for increase of water rates in Paterson, Passaic, and other New Jersey communities. The State Public Utilities Commission holds that the East Jersey Water Co. is not a public utility but is a holding company, and that the water rates must be fixed separately for each of the associated companies in the municipalities that they supply.

Federation Officers Confer With President Harding

The work of the Federated American Engineering Societies was discussed April 11 when Mortimer E. Cooley, the president of the Federation, and L. W. Wallace, its executive secretary, conferred with President Harding. The President showed keen interest in the organization and recalled the part which Secretary Hoover took in its formation.

Dean Cooley told the President that the federated societies would concentrate attention in the immediate future on reforestation, elimination of waste in American agriculture and industry, and on the reorganization of the federal government. The President's attention also was called to a list of the activities which have concerned the federation since its founding seventeen months ago. These were handed to the president in typewritten form. Quite to the surprise of Dean Cooley and Mr. Wallace the President proceeded to analyze them on the spot. The list is as follows:

Investigation of industrial waste; participation in the settlement of jurisdictional disputes among unions of the construction industry; study of the relative merits of the eight-hour and twelve-hour shifts in continuous-process industries; actively supported Patent Office Relief Bill, topographic survey bills, business-cycle bill, railway transportation bills, and legislation providing a commissioned status for sanitary engineers of the U. S. Public Health Service; study of the Muscle Shoals and Great Lakes-St. Lawrence waterway projects; participation in the unemployment conference's investigation of business cycles; participation in the activities looking to the reorganization of the Federal Government's executive departments, including the bill providing for a Department of Public Welfare, and particularly proposals looking to the establishment of a Department of Public Works; participation in numerous conferences called by the Department of Commerce.

Business Engineering Conference to Be Held in Pittsburgh

Country-wide interest in the second public conference on commercial engineering to be held May 1 and 2 at Carnegie Institute of Technology, Pittsburgh, is reflected by the large number of delegates already appointed. Dr. Glen Levin Swiggett, of the U. S. Bureau of Education, in Washington, chairman of a national committee appointed by the U. S. Commissioner of Education to investigate business training of engineers and engineering training for students of business, announces that "the primary purpose of the Pittsburgh conference is to promote plans for better co-ordination of the major operations in industry and commerce. Internationally known business men and engineers have been invited to address the conference on major topics relating to the co-ordination of college training with the industrial demand, to civic and social training of the engineer and business man, and to the training of the engineer for management of over-seas engineering projects."

The committee is composed of prominent deans of schools of engineering and of commerce in our larger universities, and of engineers and business men who are nationally known for their interest in the reduction of the costs of production, distribution, transportation, etc., through better training in schools and colleges of the personnel of industry and commerce.

Prominent educators, engineers and business executives are announced as speakers and group chairmen at both sessions of each day. Included among these are: Dugald C. Jackson, professor of electrical engineering, Massachusetts Institute of Technology; Henry Rand Hatfield, dean of the faculties, University of California; P. F. Walker, dean, school of engineering, University of Kansas; R. L. Sackett, dean, school of engineering, Pennsylvania State College; C. R. Dooley, director, personnel and training, Standard Oil Co., New York City; W. E. Mott, director, college of science and engineering, Carnegie Institute of Technology; C. R. Mann, chairman of operations and training division, War Department, General Staff, Washington, D. C. Arthur Morgan, president, Antioch College; Dexter Kimball, dean, school of engineering, Cornell University; F. B. Jewett, vice-president, Western Electric Co., New York City; Samuel Insull, president, Commonwealth Edison Co., Chicago; F. M. Feiker, vice-president, McGraw-Hill Co., Inc., New York City; L. W. Wallace, executive secretary, Federated American Engineering Societies, Washington, D. C.; and Eugene Meyer, Jr., director, War Finance Corporation, Washington, D. C.

Bonds for Street Widening Voted at Milwaukee

A bond issue of $2,500,000 has been authorized by the voters of Milwaukee, Wis., for widening Cedar and Biddle Streets from Sixth St. to Juneau Park on Lake Michigan to a probable width of 160 ft. This is in addition to $1,600,000 bonds voted in 1920 for the same general purpose, of which amount $600,000 was for a bridge across the Milwaukee River to unite the two streets which are to be widened. These streets are the main approach to the civic center site which has been approved by popular vote. The cost of the improvement will be met by excess condemnation.

A small adverse vote on a proposed five-mill annual tax levy for city planning purposes, to yield about $400,000 a year, was cast at the first of the two elections noted above. It is expected to bring it to vote again as soon as possible.

Would Have Engineers Conduct Coal Investigation

That engineers should comprise the personnel of a commission which may be authorized by Congress to investigate the coal situation suggested by Nelson P. Gaskill, chairman of the Federal Trade Commission, in testimony before the House Committee on Labor. Mr. Gaskill opposed coal operators or miners sitting on such a body on the ground that they were interested parties. "A body of engineers and disinterested men with power to employ necessary advisors, accountants, freight experts and transportation men," he said, "would be best equipped to get the information and recommend conclusions."

Traffic Problems To Be Discussed

The program of the annual meeting of the National Highway Traffic Association, which is to be held May 12 at the Automobile Club of America, New York City, has been announced by President Arthur H. Blanchard. Among the subjects listed for discussion are traffic safety, regulations governing speeds, weights and dimensions of motor trucks and trailers, license fees and highway franchises.

The national chairmen who have been asked to make reports at this conference are: Elmer Thompson, secretary, Automobile Club of America, on uniform highway signs; Herschel C. Smith, assistant professor of highway engineering, University of Michigan, on traffic capacity and widths of highways outside of municipalities; H. Eltinge Breed, consulting engineer, New York City, on the status of the construction of highway curves and recommended practices to increase traffic safety; F. W. Fenn, secretary, national motor truck committee, National Automobile Chamber of Commerce, on highway transport franchises; Tom Snyder, secretary, National Association of Commercial Haulers, on highway transport clearing houses; George H. Pride, president, Heavy Haulage Co., New York City, on regulations governing speeds, weights and dimensions of motor trucks and trailers; and, Henry G. Shirley, roads and sanitary engineer, Baltimore County Roads and Sewerage Department, on license fees and motor vehicle taxation.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York City; Annual Meeting, New York City, May 12.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The Lincoln (Nebraska) Chapter, A. A. E. will hold its next meeting on May 15. A. C. Everham, western contract manager of the Raymond Concrete Pile Co., will give an illustrated talk on the Raymond methods and J. G. Aldrich of Woods Bros. Construction Co. will show moving pictures of the Bignell pile.

The Florida Engineering Society will hold its annual meeting at Daytona, Fla., May 15 and 16. Reservations may be made through the secretary, J. R. Benton, Gainesville, Fla.

PERSONAL NOTES

FREDERICK J. PARKER, formerly secretary of the Arthur McMullen Co., announces the severance of that connection and the formation of the general contracting organizations of the Parker-Sawyer Co., railroad and general construction and of the Engineering Construction Corp., highway contractors both of Philadelphia, Pa.

H. A. DUNLAP and JOHN J. WARD have formed the firm of Dunlap and Ward, building contractors, St. Louis, Mo. Mr. Ward was formerly president of the T. J. Ward Construction Co., both of St. Louis.

JAMES N. GLADDING, city manager of Albuquerque, N. M., and his brother, RAYMOND D. GLADDING, have organized the firm of Gladding & Gladding, consulting engineers, with offices in Albuquerque, N. M. and El Paso, Texas. James Gladding will continue to act as city manager until June 5.

C. R. WRIGHT, port engineer of the Port of Hoquaim, Wash., has resigned. His successor has not yet been named.

HARRY S. LEYDEN, chief inspector of highway construction of Fresno County, Cal., has been appointed county superintendent of highway construction and maintenance. His appointment is effective July 1.

G. W. BEAR, general bridge inspector for the Southern Pacific Co., has been appointed engineer of bridges with jurisdiction over all bridges, tunnels, wharves and ferry slips on the Pacific System.

J. J. HEDRICK, JR., county engineer of Hillsborough County with headquarters at Tampa, Fla., has resigned to enter the contracting field. ALLAN PIMM, his assistant, has been appointed county engineer.

WEBSTER L. BENHAM, under the name of the Benham Engineering Co., has taken all the contracts of Benham & Mullergren, Kansas City, Mo. A. L. MULLERGREN has retired from the firm to engage in private practice in Kansas City.

LESTER J. KALEY, for four years superintendent of buildings, Binghamton, N. Y., has resigned to devote his time to private practice as a member of the firm of Vosbury & Kaley. D. W. JONES, who was at one time inspector of public works for Binghamton, succeeds him.

L. A. DOAN, until recently assistant engineer of bridge construction, Indiana State Highway Commission, has been appointed assistant district engineer in charge of bridges for the upper peninsula of Michigan.

WILLIAM L. MCCREDIE, recently field engineer for the Columbia River Basin Survey, has been appointed assistant engineer for the joint management of the Puget Sound Electric Ry. and the Tacoma Ry. and Power Co.

WILLARD E. FREELAND, who was an associate editor of *Iron Age* for four years and recently superintendent of sales production for the Winchester Repeating Arms Co., has accepted a professorship at Massachusetts Institute of Technology.

N. S. KLINK, formerly engineer with C. T. Main, Boston, Mass., has opened his own office in Boston for the practice of architecture and general engineering.

FRED EMERSON, assistant city engineer, Lockport, N. Y., has been appointed city engineer of Batavia, N. Y.

GORDON L. SHANKS, who spent the past year in Mexico on construction work for the Foundation Co., has been appointed municipal engineer for Rockwood municipality near Winnipeg, Manitoba.

THE HIRAM PHILLIPS ENGINEERING CO., St. Louis, Mo., successor to W. R. Heagler & Sons, Paragould, Ark., and Hiram Phillips, St. Louis, Mo., will specialize in drainage, flood protection, irrigation, sewerage and water supply.

OBITUARY

LAWRENCE BATES JENCKES, of Crompton-Knowles Loom Works, Worcester, Mass., died recently at his home in Worcester. He was a graduate of Yale Sheffield Scientific School and at one time city engineer of Stamford, Conn.

GEORGE R. DAVIS, engineer in charge of the Pacific division of the U. S. Geological Survey, died recently in San Francisco. He had been connected with the Geological Survey for 25 years.

ROBERT BRISBANE, senior construction superintendent for the J. G. White Engineering Corp., died April 16 in New York City. He had recently completed the station of the Radio Corp. of America at Bolenas, Cal.

GEORGE D. BROOKE, formerly superintendent of equipment and machinery of the Iowa Central and Minneapolis & St. Paul railways, died recently at his home in Minneapolis, Minn. Before retiring from active engineering practice he served in the Panama Canal Zone as assistant, first to chief engineer J. F. Wallace, and subsequently to chief engineer J. F. Stevens, and General Goethtals. Among his other duties he was in direct charge of field and shop work necessary for the maintenance of motive power and machinery.

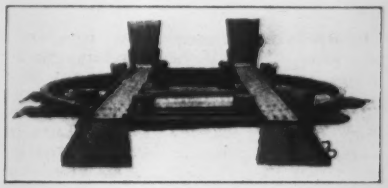
JOHN EICHLEAY, JR., founder and president of the John Eichleay Jr. Co., died April 15 at his home in Pittsburgh, Pa. The firm specialized in structural-steel erection, shoring work and foundations.

EQUIPMENT AND MATERIALS

Roadbuilders' Portable Turntable

A new turntable for use in the construction of roads consists of a circular track mounted on skids which serve for moving purposes. On the circular track is mounted the carriage which consists of a pair of runways with hinged approaches at each end. These runways are rigidly fastened together and near the end of each runway is attached a pair of flanged rollers or wheels, one roller on each side of the runway. The rollers are properly aligned to correspond with the circular track.

The extreme height that the track must rise above grade to mount the



turntable is 10 in. and with the easy approaches provided at the ends of the runways the driving on or over the turntable is accomplished without difficulty.

The best results according to the makers, the Western Structural Co., Moline, Ill., are obtained when the turntable is moved 500 or 600 ft. at a time. The table is moved by a chain hitch to a passing truck which drags it to its position.

Crawler Tractors for Railroad-Type Shovels

Railroad-type shovels of all kinds and sizes may now be equipped with caterpillar-type traction. The Bucyrus Co., South Milwaukee, Wis., makes a mounting of two forward driving crawlers replacing the jack arm and two rear crawlers mounted under the rear end of the shovel. The front crawlers are so designed that they can swivel and adjust themselves to unevenness of the ground. The speed is ½ mile per hour and the traction power is sufficient to enable the shovel to climb 15 to 20 per cent grades. The rear crawlers consist of two units mounted in the same frame.

Steering is accomplished through the rear crawlers. A massive steering arm,

integral with the pintle of the rear trucks, carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center valve, reverse-type engine, suspended below the car frame. Steering in curves of large diameter may be accomplished by merely swinging the boom.

Advantages claimed for this mounting are as follows: Time is saved, as only 10 sec. are required for an ordinary move; no rails are to be laid nor jacks to be released and reset. Since the shovel can be moved quickly it does not have to face blasting, and in emergencies, such as slides, can be moved out of danger. It saves two to four pitmen and in soft ground requires blocking only under the crawlers.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Rapid Fire Survey of Business Conditions

Democratic finance must develop a new idea. "We have only one string in our bow, Taxation, and for my part I think it is insufficient," said Lord Milner, some six years ago in the board room of the Rhodes Trust, London. Elaborating upon the idea of creative economics in government he cited the tax-earning power of the Assouan Dam and the Suez Canal. A well known critic recently wrote: "Finance ministers instead of being tax collectors will have to study creative economics and become makers of wealth . . . turn themselves into springs instead of cisterns."

Ingot production per working day in the last four months has shown remarkable increase. Figures for the thirty companies reporting to the American Iron and Steel Institute are as follows:

	Daily Output, Gross Tons	Increase Over Previous Month Tons	Per Cent
December	54,884	...	...
January	61,326	5,442	9.9
February	72,709	11,383	18.6
March	87,806	15,097	20.8

Steel common crossed par for the first time in two years. A million shares have been changing hands each day. On Apr. 21, 1920, the high was 102⅜; in 1921 quotations declined to 70¼, the lowest since 1915, and this week ranged from 99½ on Saturday, Apr. 22 to 98 on Monday, Apr. 24.

Employees in 113 iron and steel establishment reporting to the Department of Labor numbered 120,663 in March, against 134,421 a year ago, and the payrolls were $5,341,971 and $8,185,422, respectively. Per capita earnings increased 4.3 per cent over the preceding month.

Cost-of-living changes in twenty-eight cities, according to the Bureau of Labor Statistics:

City	Per Cent of Decrease from — June 1920 to March 1922	Dec. 1921 to March 1922
Baltimore	21 7	3 1
Boston	23 5	5 3
Buffalo	23 3	3 9
Chicago	23 1	4 2
Cincinnati	24 0	3 0
Cleveland	23 3	5 8
Denver	21 2	4 8
Detroit	26 0	4 3
Houston	21 2	3 7
Indianapolis	23 2	3 4
Jacksonville	22 4	4 1
Kansas City, Mo	23 6	5 9
Los Angeles	14 5	2 3
Memphis	18 6	3 2
Minneapolis	18 4	3 1
Mobile	24 7	4 8
New Orleans	15 5	2 3
New York	22 5	4 6
Norfolk	22 9	4 4
Pittsburgh	21 3	4 4
Portland, Me	22 6	5 0
Portland, Ore	24 0	3 8
Richmond	21 5	4 6
St. Louis	23 0	3 2
Savannah	25 1	5 6
Scranton	20 5	4 7
Seattle	20 5	2 4
Washington	22 1	3 8

Wholesale prices changed only one point in March, from 151 to 152, according to the Bureau of Labor Statistics index.

Meat for export averaged 14⅜c. per lb. in 1921, against 23.84c. in 1920, 30.38c. in 1919, and 11.73c. in 1913.

Building index number of the Bureau remains at 202, against 208 one year ago. A revised index number, including structural steel and other important building materials, and with prices weighted by 1919 instead of 1909 census data, are as follows: March, 1921, 173; February, 1922, 156; March, 1922, 155.

500 truckloads of money of the highest denominations, 10,000 to 50,000 rubles notes, are reported to have been sent out of Moscow in 1921. Four printing works employing 20,000 men operated day and night.

Russia is fast reaching a sound economic basis as a result of removing the Soviet ban on capitalism, according to former Governor James P. Goodrich of Indiana, who has just returned from that country. Quantities of gold are now circulating, although trade is mostly carried on with the depreciated paper roubles — 1,000,000 for a gold ruble. In trade Germany ranks first, England second, Sweden third, and the United States fourth.

An Economic Institute to supply business data to individuals, companies and Government officials has been established by the Carnegie Corporation of New York, and $1,600,000 set aside to finance the project for ten years.

Business done in week ended Apr. 19, as measured by total debits to individual accounts reported by 165 clearing house associations, amounted to $8,797,263,000, compared with $8,414,492,000 for the preceding week. Improvement in New York over last year is 26 per cent, due principally to increased activity of the stock market.

Lumber demand increased 2½ per cent during week ending Apr. 15. Production 15 per cent and shipments 5 per cent below normal according to reports of National Lumber Manufacturers' Association from 377 mills.

Cement Production in March totaled 6,685,000 bbl., against 4,278,000 in February; stocks, 13,824,000 bbl., compared with 14,142,000 bbl. in February.

March cargoes, import and export, show increase of 23 per cent over previous month. Increase in exports of 575,000 tons; imports 1,157,000 tons. American ships carried 35 per cent of both the import and export trade in dry cargo and 77 per cent of the total tanker trade.

Car Surplus, Shortage and Freight Loadings

Reports of the Car Service Division of the American Railway Association show 714,268 cars loaded with revenue freight for the week ending Saturday April 8, 1922, a reduction from the previous week of 112,743 cars. Compared with the corresponding week in 1921, however, this is an increase of 19,387, but on the other hand, for the same period in 1920 it is 87,291 cars less.

The period covered by this report includes the first full week of the coal miners' strike, and the loss in revenue freight loaded is of course, largely due to the decline in coal loading, 115,496 cars fewer being loaded than in the week ending April 1. Coke also decreased 2,053 cars.

That the strike of the miners and the consequent curtailment of bituminous and anthracite production did not adversely affect general business during the first week, notwithstanding some reports to the contrary, would seem to be disclosed by the report of revenue freight loaded other than coal and coke for that week. Merchandise l.c.l. and miscellaneous combined, show a gain of 6,041 cars over the preceding week. Forest products increased 664 cars, and ore 2,448 cars. Live stock loading was 911 cars less than in in previous week. Grain and grain products is the only commodity other than coal which shows a marked falling off. The loading of this commodity has been steadily decreasing for a number of weeks past. The loading for week ending April 8 was 3,436 cars less than the previous week.

Serviceable surplus cars totaled 259,605 for the week ending April 8, or 52,859 cars more than for the week ending April 1. Of these, 92,393 were box cars, 122,359 were gondolas, balance miscellaneous. Compared with the previous week box cars increased 3,902 and gondolas 49,793.

SURPLUS AND SHORTAGE STATEMENT—APRIL 1 TO 8, 1922

Districts	Flat Cars Surplus	Flat Cars Shortage	All Box Cars Surplus	All Box Cars Shortage	All Coal Cars Surplus	All Coal Cars Shortage	Total All Cars Surplus	Total All Cars Shortage
Eastern	1,620	...	17,381	...	46,684	...	69,700	
Allegheny	912	...	14,323	...	41,054	...	58,040	
Pocahontas	227	...	632	...	5,960	...	7,885	
Southern	3,045	37	7,256	154	7,928	64	22,090	263
North Western	1,195	...	23,033	...	2,552	...	32,649	
Central Western	1,617	...	20,871	25	15,896	50	54,331	75
South Western	814	3	8,897	6	2,283	...	14,910	11
Total	9,430	40	92,393	185	122,359	114	259,605	349
Canadian Roads	4,165	...	25,815	...	1,350	...	39,225	
Grand Total	13,595	40	118,208	185	123,709	114	298,830	349
March 31, 1922	15,680	27	110,676	255	73,841	77	243,236	423

Cement Output Steady for First Quarter

Statistics prepared by the United States Geological Survey show cement production for the first quarter of 1922, at 15,254,000 bbl. as against 15,240,000 bbl. for the same period in 1921. Shipments totaled 13,218,000 bbl. as compared with 12,091,000 bbl. for the first three months of 1921. Although the production rate, for the first three months of 1922, is practically the same as that for the first quarter of last year, increased shipments over last year indicate growing demand. Stocks on hand at the end of March, 1922, aggregated 13,824,000 bbl. as compared with 12,000,000 bbl. on Mar. 31, 1921.

Department of Commerce reports show imports of hydraulic cement in March amounting to 1,597 bbl., valued at $4,308. The total for 1921 was 122,317 bbl., worth $388,828. March imports were from Mexico, 902 bbl.; France, 322 bbl.; Japan, 253 bbl.; other countries, 120 bbl. Total exports of hydraulic cement in 1921 were 1,181,014 bbl. valued at $4,276,986.

Bids Wanted on Big Jobs

Among this week's announcements on contracts let in Construction News, pp. 195 to 209, are the following large projects: Part of 14th St.-Eastern Rapid Transit R. R., Brooklyn, N. Y., to Joslin Constr. Co., Inc., 354 West 24th St., New York City, $1,149,196; a high school at Brooklyn, N. Y., to G. Colon Co., 81 East 125th St., New York City, $1,266,621; a science hall and office building at Washington, D. C., to T. T. Wills, 286 5th Ave., New York City, $2,000,000; a store building at Richmond, Va., to J. T. Wilson, Mutual Bldg., Richmond, $1,000,000; a hotel at Charleston, S. C., to J. W. Cowper, Oliver Bldg., Pittsburgh, Pa., $1,000,000; a 16 mi. pipe line from Swan Lake to Volunteer Park, Seattle, Wash., to Grant, Smith & Co., Henry Bldg., Seattle, $1,468,603.

Big Highway Program Under Way in Texas

Texas has over 2,000 miles on state highways under construction according to the reports received by the U. S. Bureau of Public Roads. This includes 146 miles of concrete and brick pavements, 425 miles of bituminous pavements, 1,190 miles of gravel and macadam roads and the remainder sand-clay, shell and earth roads. This large program is estimated to cost about $28,700,000 of which amounts $13,300,000 is to be paid by the state and federal governments, leaving about $15,400,000 to be paid by the counties and road districts.

New work to be undertaken this year will amount to about 1,350 miles estimated to cost $17,265,000. This work will be financed 25 per cent by the state and 25 per cent by the federal government, and 50 per cent by counties and road districts. All federal-aid funds apportioned to Texas have been definitely allotted to projects, according to J. D. Faultleroy, state highway engineer.

Last year 1,078.5 miles of state roads were completed at a cost of $10,637,821.47 but this year's work is expected to exceed these amounts by at least 50 per cent.

Indicates Senate Views on Tariff Now Before It

Initial discussion of the tariff bill in the Senate reveals that there is practical unanimity of opinion in that body that the ad valorem rates in the bill should be based on a valuation made in the country of origin. Sentiment in the Senate seems to be as strongly opposed to American valuation as that of the House is in favor of it. Approximately 60 per cent of the commodities covered by the dutiable list take ad valorem rates. The remainder of the articles on the dutiable list are covered by specific rates. Every effort was made by the Finance Committee to apply specific rates wherever possible but the difficulty is that in many cases specific rates are impracticable.

In the bill which the Finance Committee has reported, Senator McCumber believes there is no rate so low that it will compel the American producer to surrender the American market to the foreign producer, if he exercises proper economy in the manufacture and marketing of his product. On the other hand, he believes, no rate is so high as to prevent reasonable foreign competition. He expects to see the Tariff Commission become a forum in which any complaints may be lodged as to the unfairness or the injustice of any rate. With the powers given to the President, it will be possible to rectify any injustice that may be worked by reason of rapidly changing conditions. The bill as reframed in the Senate is expected to yield $350,000,000 annually.

Earnings of Well-Known Companies in 1921 and 1920

Annual financial statements of sixty-six well-known American business organizations, as reported to newspapers, show twenty-seven returned deficits in 1921 as compared with ten in 1920.

Appreciable gains in earnings were shown by communication and motor companies. Oil concerns returned largest profits. Among the dye industries, the Allied Chemical & Dye Corp. earned $13,093,889 in 1921 as compared to $29,768,751 in 1920.

Three of five steel firms listed showed heavy losses for the year 1921 while no deficits were registered for these companies in 1920, according to the compilation. Mining enterprises returned small amounts, two showed heavy drops in both years. Most railroads in the list remain with deficits.

Following are net earnings or losses of the companies:

Company	Net Earnings or Losses (Deficits shown in italics) — Total		Per Share, Com.	
	1921	1920	1921	1920
Ajax Rubber Co.	*$5,205,577*	*1,333,368*		
All America Cables, Inc.	3,255,794	22,130,500	14.71	18.39
Allied Chemical & Dye Corp.	13,093,889	29,768,751	2.28	6.33
Allis Chalmers Co.	2,215,468	3,564,249	4.07	9.26
Amalgamated Leather Co.	*1,863,920*	*3,778,413*		
American Bosch Magneto Co.	*236,177*	1,595,962		
American District Telephone Co.	979,984	545,043	9.83	5.46
American Glue Co.	496,110	830,445	8.87	15.35
American Public Service Co.	2,665,304	2,088,065	.....	.....
American Radiator Co.	3,178,776			
American Smelting & Refining Co.	9,481,471	15,747,715		
Associated Oil Co.	8,157,952	8,807,718	20.52	22.15
Atchison, Topeka & Santa Fe Ry.	39,331,661	37,634,751	14.69	13.98
Atlantic Lobos Oil Co.	681,000	1,051,915	.....	.....
Atlantic Refining Co.	*3,740,261*	10,513,694	.....	.....
Boston & Maine R.R.	*7,348,086*	*17,132,481*	.....	.....
California Petroleum Corp.	2,418,448		9.29	.....
Calumet & Arizona Mining Co.	*694,879*	*1,979,922*	.....	.....
Calumet & Hecla Mining Co.	*1,491,260*	3,823,743	.....	.....
Chicago Great Western R.R.	592,601	1,548,378	.....	.....
Chicago & Western Indiana R.R.	640,142	516,411	12.80	10.33
Fairbanks-Morse Co.	*4,236,871*	2,778,735	.....	.....
General Electric Co.	28,155,667	26,420,616	.....	.....
Goodyear Tire & Rubber Co.	3,620,043		.....	.....
Harbison-Walker Refractories Co.	1,751,444	2,869,996	5.75	8.79
Hupp Motor Car Co.	890,278		1.59	.....
Inspiration Consolidated Copper Mining Co.	*1,790,421*	2,294,276	.....	.....
International Harvester Co.	4,149,900	16,655,300	.....	.....
Keystone Telephone Co. of New Jersey	*67,937*	80,281	.....	.....
Lackawanna Steel Co.	1,465,222	.....	.....	.....
Louisville & Nashville R.R.	*407,391*	.....	.....	.....
Maine Central R.R.	*2,165,361*	.....	.....	.....
Massachusetts Gas Co.	1,753,657	1,938,979	7.01	7.75
Miami Copper Co.	*564,244*	1,394,251	.....	.....
Nashville, Chattanooga & St. Louis R.R.	*259,801*	*1,956,843*	.....	.....
Norfolk & Western R.R.	9,123,489	11,577,096	7.50	9.52
Northern States Power Co.	12,963,222	11,798,778	.....	.....
Otis Elevator Co.	2,100,546	2,880,277	12.02	26.25
Peerless Truck & Motor Co.	*103,665*	1,063,306	.....	.....
Pennsylvania R.R.	*1,793,492*	*1,811,348*	.....	.....
Phelps-Dodge Corp.	*10,389,068*	3,766,888	.....	.....
Pittsburgh, Cleveland, Cincinnati & St. Louis R.R.	7,660,231	4,183,626	.....	4.93
Radio Corp. of America	4,160,844	426,799	2.11	.....
Rock Island & Pacific Ry.	5,780,259	4,663,155	2.95	1.46
Rumely Co.	1,353,452	4,971,129	.....	.....
Shattuck & Arizona Copper Co.	*33,862*	*239,115*	.....	.....
Sloss-Sheffield Steel & Iron Co.	*1,113,417*	1,893,779	.....	14.24
South Penn Oil Co.	464,652	5,489,591	.....	.....
Southern Phosphate Corp.	314,749	575,075	.....	.....
Southern Ry. Co.	13,971,781	15,325,802	.....	.....
Standard Oil Co. of California	33,588,231	41,655,254	8.45	
Standard Oil Co. of Kansas	207,789	2,043,449	10.38	102.17
Standard Oil Co. of Ohio	17,344,463	14,856,326	51.00	62.00
Steel Co. of Canada, Ltd.	*442,449*			
Stromberg Carburetor Co.	81,670	340,101	1.08	4.53
Submarine Boat Co.	*6,611,997*	*1,865,995*	.....	.....
Transcontinental Oil Co.	*2,902,374*	510,144	.....	.....
Union Tank Car Co.	1,002,625		1.35	24.08
United Gas Improvement Co.	2,717,032	2,303,876	1.88	1.81
United States Rubber Co.	*6,591,896*	4,015,217	.....	.....
United States Steel Corp.	*$92,708,829	*$177,174,126	.....	.....
J. G. White Companies	*226,484*		.....	.....
White Oil Corporation	*610,215*		.....	.....
Wickwire Spencer Steel Co.	*3,635,000*	662,116	.....	.....
Willys-Overland Co.	*23,560,389*	*9,338,716*	.....	.....

*Includes charges for interest, sinking fund and depreciation.

German Business Fears Result of Rise in Mark Exchange

A news dispatch to the *New York Times* reports that with the improvement of mark exchange, the approximation of domestic prices to those in the world markets and an increasingly acute money shortage, the Berlin Boerse is suffering a "panic of economic pessimism." Many stocks have tumbled from 50 to 150 points.

Domestic prices have increased so materially that the German advantage in world markets has been whittled to almost nothing, and her export trade and export industries are in for a hard time. With the rise of the mark, domestic purchasing power has shrunk and a period of business stagnation has set in. Crop forecasts, moreover, are unfavorable and a money and credit shortage have increased the general nervousness to panicky pitch.

To Move Hotel Building Across Street

A contract has been awarded to John Eichleay, Jr., Pittsburgh, for the removal of the Hotel Truax building, Syracuse, N. Y. from its present site to a site directly across the street recently purchased by the hotel corporation. The Hotel Truax building is a three-story brick with stores on the ground floor, and is about 150 ft. by 80 ft.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 6; the next, on May 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.48	$3.35	$4.00	$2.38	$2.66	$3.30	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.35	3.90	5.50	3.00	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.38	3.25	3.50	2.28	2.56	3.47½	—2.55	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	44%	58.8%	53%	30.00
Cast-iron pipe, 6in. and over, ton	47.30	42.00	48.30	43.10	48.00	52.00	+50.00	51.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	1.97	2.24	2.90	2.73	2.94	2.50
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	36.00	33.50	41.00	+39.00	34.75	28.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	+2.80	11.00
Common brick, delivered, 1,000	19.90	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	.12	.095
Hollow partition tile 4x12x12, block	.11120	.0625	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.89	+.96	1.09	.90	+1.02	1.05	.94	.86	1.05
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.....	.20	.25	.72½	.40@.50	.35@.40	.47½@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.78 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Firmness in finished steel products is the outstanding feature of this week's market. Structural shapes and reinforcing bars quoted at $1.60 per 100 lb., Pittsburgh, by several large producers. Orders where specifications are especially attractive to makers and buyers are not particular as to deliveries, represent the only quotations remaining at $1.50.

Increasing fuel costs, due to the present coal strike, are causing firmer pig iron prices in all districts. Cast-iron pipe prices also firmer. San Francisco quotes 6-in. pipe at $50 as against $48 per ton.

Long leaf yellow pine, base sizes, quoted in Minneapolis at $39 as compared with $38 per M. ft. b. m., one week ago. Lumber prices elsewhere showing downward tendency.

Common lump lime quoted at $2.80 as against $2.75 per bbl. (180-lb. net) in Seattle. Raw linseed oil quoted at an advance of 5c. in New York and Minneapolis and 3c. per gal. (5 bbl. lots) in Atlanta.

The Cleveland market quotes delivered prices on the following materials: crushed stone, $3.25 per ton; common brick, $14 @ $16 per 1,000; hollow tile 8 x 12 x 12, $143, and 8 x 5 x 12, $50 per 1,000.